Lead by Example:

An Exploration of STEM School

by:Nicholas Pietron

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An Exploration of STEM Schools

A Design Thesis Submitted to the
Department of Architecture and Landscape Architecture
of North Dakota State University

By

Nicholas J. Pietron

In Partial Fullfillment of the Requirements
for the Degree of
Master of Architecture

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Table of Contents

This thesis is an exploration into the fundamental question: can educational architecture be specifically designed to optimize one's ability to attain certain knowledge? The title is *Lead by Example: An Exploration of STEM Schools* and I will conduct this investigation through an 80,000 square foot STEM School in Fargo, North Dakota. The Theoretical Premise that drives this project is: In order for specific knowledge to be transferred to a Seeker of Knowledge, in the best possible fashion, educational architecture must be carefully designed and crafted to create the optimal environment for the event to take place. The reason behind this investigation is because in today's society, the quality of attention that is required when designing educational environment is absent. This must be addressed. Finely crafted educational environments will beget the enrichment of knowledge into one's life, inspiration and innovations are soon to follow, paving the way for an enhanced society and a better tomorrow.

Can educational architecture be specifically designed to optimize one's ability to attain certain knowledge?

The Project Typology:

A STEM Middle School

The Claim:

Through thoughtful design, educational architecture can be crafted into an environment that optimizes an individual's ability to attain specific knowledge.

Premises :

Premise One:
It is principle that the architectural design is present in educational design so that it may shape an environment where learning can be best fostered.

Premise Two:
Because the recipient of knowledge's ability to gain specific knowledge is in direct correlation with architecture's design, the architect should fully understand this specific knowledge.

Premise Three:
The architectural design must be driven by the specific knowledge.

The Theoretical Premise/Unifying Idea:

In order for specific knowledge to be transferred to a Seeker of Knowledge, in the best possible fashion, educational architecture must be carefully design and crafted to create the optimal environment for the event to take place

Project Justification:

In today's society, the quality of attention that is required when designing the educational environment is absent. This must be addressed. Finely crafted educational environments will beget the enrichment of knowledge into one's life; inspiration and innovations are soon to follow, paving the way for an enhanced society and a better tomorrow.

Proposal

“The task of the modern educator is not to cut down jungles, but to irrigate deserts.” (atd. in Heck, 2006)

In today’s “information age”, we can receive information and ingest it almost instantly. This instant gratification of information seems to weaken the power that information once had. It is not a bad thing to be more informed, but this information is not knowledge. The difference between information and knowledge is a certain level of discipline; knowledge is something earned. It is earned through experience, research and practice. It is through this process of earning that enriches knowledge and in turn enriches the one with it.

As a human being, taking my place in society, education has always been a source of interest to me. The institution that is responsible for the transfer of knowledge to those who need it and seek for it has fascinated me in the regards to its methodology. Children are natural knowledge seekers; they thirst to know more and more. It is crucial for the educational system to deliver knowledge to these young minds, so they may develop into cultivated individuals with endless possibilities for further development. As a husband to a teacher, I am allowed some insight to education’s modern methods. This insight allows me to integrate current education techniques into my design, while allowing me to also interact with established schools to further my research. As an architect, I have to believe that an environment can be designed to optimize a child’s ability to receive/gain knowledge, and for the educators to be able to effectively deliver it. Finally, as a father, I am concerned about the education that my child will receive, and how she will grow in today’s society.

“Education, then, beyond all other devices of human origin, is the great equalizer of the conditions of men, the balance-wheel of the social machinery.”(Mann, 1848)

The clients for this project is a husband-wife team: David and Lindsay Larson. David is a philosophy professor at NDSU, with an interest in epistemology, and Lindsay is a middle school teacher in the Fargo school system. David was elected by the district school board to review design summations and act as the district’s representative throughout the design phase of a new middle school for south Fargo.

With David’s philosophical interests in knowledge and Lindsay’s insights into the current educational system: growing trends, problems and effective techniques. These skills allow the design to take a fundamental look into the practical delivery of knowledge to students.

This building will be used in the education of middle school students and the school will be formatted in the form of a STEM School. STEM is an acronym for Science, Technology, Engineering, and Mathematics (STEM). These educational facilities have been around since their inception in 2006 in response to student’s substandard knowledge in STEM subjects. The approach that David and Lindsay want to take will utilize the STEM School’s curriculum and infuse it with Art education. The clients believe that the application of STEM studies needs to take on a more tactile approach. With this tactile, approach they hope to foster creativity into their students so that they may turn this into practical innovation, self expression, and confidence.

The building will house up to two grades (seventh and eighth) with an approximate student load of 300 individuals with 30 facility members to engage students in a separate more intimate environment to allow for more student-teacher time. They want spaces for lecturing, break-out discussion spaces and spaces for arts and physical education. All the spaces will comply with federal requirements and completely accessible to every individual.

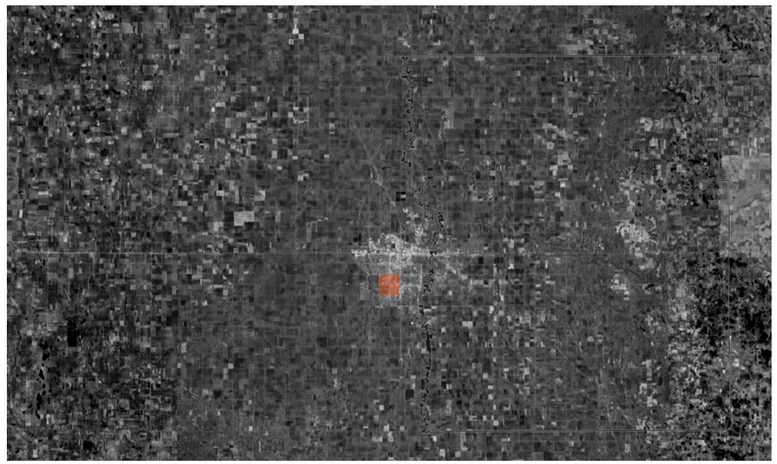
DAvid and Lindsay want these spaces to harmonize with one another with the us-age of as many possible passive methods of energy savings that will further inform students to the importance of the natural and built environments. This includes many view onto the site when appropriate and limiting view when appropriate, i.e. lecture halls. They also want the building to speak of its structural methods, so the studesnts may see practical applications of the subjects that they are studying to further their interests.

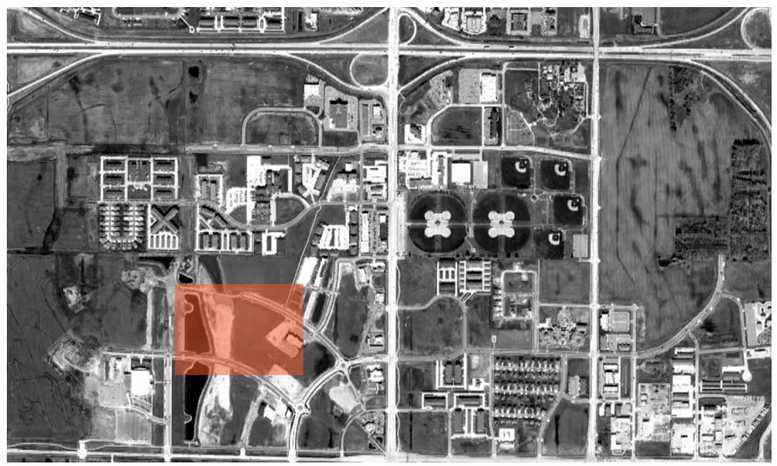
Exterior Elements

- Bus Loading Area
- Faculty, guess and Administration Parking
- Material Loading Area
- Physical Education Area
- Outdoor Classrooms

Interior Elements

- Lecture Halls
- Break-out Spaces
- Administration
- Faculty
- Physical Education
- Lockers
- Library
- Cafeteria
- Circulation
- **Classrooms**

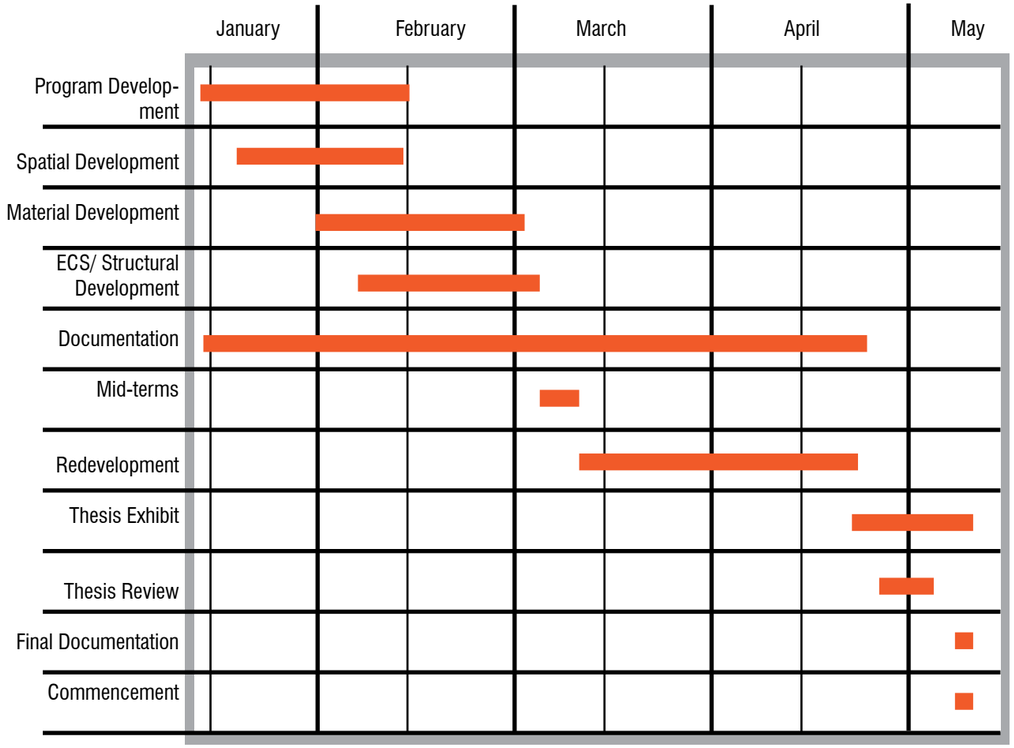




This location was chosen due to the layout of the Fargo Public School Districts. There are few schools west of 45th St. S in the ever expanding south Fargo. Here is a site that allows closer options for many residents of south Fargo. It is a versatile site with room and it offers the opportunity to beautify the area. It is restrained by 55th Ave. S. to the North, a private property to the east, and a water form to the west. It is near to 45th St. S., which is a major traffic artery, and the unique road system wsurrounding the site provides uncomplicated bus routes. The site has a unique form and promises creative solutions

Site Information:
Region: American Mid-west
City: Fargo North Dakota
Site: 55th Ave S. and 50 St. S.

The objective of this project is to explore solutions that enable young students to gain knowledge of science, technology, engineering, and mathematics, while building a relationship with the arts. To do this it is critical to examine the way knowledge is received and its relationship with the build environment.



Research:

The research that is required for this project to be successful must include:

- Theoretical Nature of Knowledge and Educational Philosophy
- Importance of Art
- Existing STEM Schools
- History of STEM Schools
- History of Art Education
- Site Analysis
- School Design
- Universal Design

Methodology:

The method that will be used will be the Mixed Method, Quantitative & Qualitative Approach with the Concurrent Transformative Approach, which will include:

- Print/ Digital Analysis:
  - Graphic Analysis
- Interviews:
  - Teachers
  - Educational Administration
  - School Board Members
- Case Study Analysis:
  - Local STEM School
  - Previously Documented

The data will be collected simultaneously as qualitative and quantitative data; all the data will pertain to and enlighten the Theoretical Premise

Documentation:

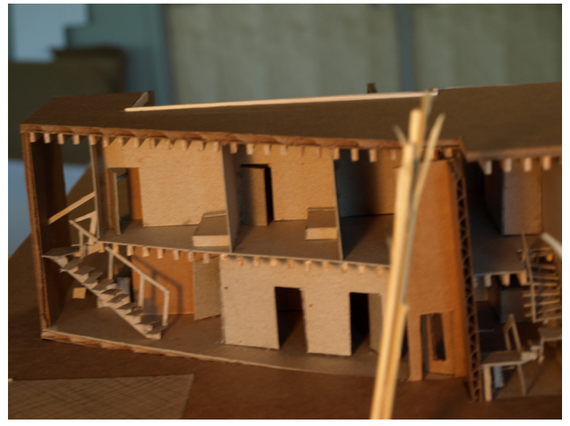
Documentation of research will be taken in written form then transferred to digital form with all accompanying analytical graphics and photo documentation will be compiled onto an organized digital compilation weekly and then graphically laid out into a cohesive PDF file. The findings will be digitally compiled but physically present during the project's display.

Previous Studio Experience

Stephen Wischer
Tea House

David Crutchfield
NDSU Downtown Library
(above)

Megan Duda
Dwelling



Bakr Aly Ahmed
S & G Corner

Don Faulkner
Marvin Window's Competition
-Place Winner

Malini Srivastava
Design:Build

Program Document

Research Results & Goals

Preface

The following body of writing is intended to explore the theoretical premise that is the driving force behind this thesis. I will explain the three premises that make up the foundation to my thesis's claim, then I will reconcile each with thoughtful esearch. With the validation of each premise, I will then summarize my finding. The claim is *Through thoughtful design, educational architecture can be crafted into an environment that best allows one to attain specific knowledge*. This is the idea that I will attempt to transform from a simple conjecture to a validated truth. I wish to open with this quotation that I found quite inspirational,

> "... knowledge must continually be renewed by ceaseless effort, if it is not to be lost. It resembles a statue of marble which stands in the desert and is continually threatened with burial by the shifting sand. The hands of service must ever be at work, in order that the marble continue to lastingly shine in the sun. To these serving hands mine shall also belong." (Einstein, 1954)

Premise One:

It is principle that the architectural design is present in educational design so that it may shape an environment where learning can be best fostered.

First, it is important to prove that architecture plays an integral role in education. Without proof of this connection, the whole of this thesis is void of truth. Iwill explore the purpose of educational facilities and how they imbue knowledge to the users. Then it will be examined against the theoretical premise to see if it justifies or contradicts it.

Educational facilities are buildings that are specifically created environments that are usually owned by government or private organizations. The specifically created environment is meant to teach a certain demographic. These demographics usually range from young children to young adults. The organizations that own the facilities usually wish to educate these individuals to prepare them for a certain role in society, i.e., a religious education center teaches many of the same rudimentary skills to their students, compared to public education, but instills a certain world view to these students that align to their shared beliefs. This is the most basic function of educational facilities: provide a place for learning. This "place" almost always takes the form of a building, so architecture is present in the educational process.

The importance of architecture to the learning environment is the real issue in this premise. In order for architecture to be relevant to the educational process, one must examine the different learning activities that occur in educational facilities. Knirk, the author of *Designing Productive Learning Environments*, suggests that, "the design of a school and its interior facilities and spaces can either help or hinder the teaching-learning process"(Knirk,1979). He then goes on to propose there are three different types of learning activities that must be planned for: passive learning, interactive learning and active learning. Passive learning occurs with little physical activity this may occur when watching video media or listening to lectures and has no limit to the amount of students that may participate in this type of learning. Interactive learning relies on a level of interaction from everyone with the class including the instructor. This is normally seen in seminar setting with small groups of people.

Lastly, active learning, this is the "learn by doing" method and usually consumes a large amount of space. Labs, computer clusters and art rooms are common active learning environments. These types of learning activate all required different spaces and must be designed respectively. (Knirk,1979)

Dudek goes on to proclaim through his research, "…good architecture can significantly enhance the experience of education. In practical terms this does not simply mean the provision of minimal comfort conditions. It requires architects to go further." (Dudek, 2000) Throughout Dudek's book *Architecture of Schools: the New Learning Environment* he mentions the responsibility that architects are faced with when they design a school. There are many different variables that are present during the design process such as: current administrations, changes in teaching methods, distribution of schooling districts, technological advancements and cultural changes. (Dudek, 2000) These are just a few issues that an
architect needs to attend. All of these veritable pale in comparison to importance of the many different learning styles that need to be addressed. Traditional postindustrial "cookie cutter" design will not suffice in addressing the many issues that are present in today's learning environments thus an architect is needed to create the best solution for the given situation.

Premise Two:
Because the Knowledge Seeker's ability to gain specific knowledge is in direct correlation with architecture's design, the architect should fully understand this specific knowledge.

Now that it is known that it is imperative that high quality architectural design is required to craft the best possible learning environment, one address how architecture will meet these challenges. Again Dudek comments that architecture for architecture's sake will fail in this challenge because of the complexity present in the program. He says, "Designers can begin to redress the balance be developing a service which optimizes the value of the school site for the whole community. Simplistic philosophies are inappropriate. The science of education in one where the developing aesthetics of childhood must be complimented by an altogether more intriguing range of special qualities." (Dudek, 2000)

The complexity of the program is derived from the many different activities that occur in the modern learning environment. Most architects are ignorant of the intricacy of these academic needs and that is why it is paramount that architects work closely with the users of these environments: children and educators. Steven Binger a collaborative writer in Elizabeth Herbert and Anne Meek's book, *Children, Learning & School Design,* mentions, "The polar relationship that educators and architects have enjoyed throughout the moden era is finally being called into question. This polarity has manifested itself in a collection of buildings that bear little relation to curriculum and a curriculum that has had little to offer to architecture."(Meek, 1992) I found this interesting because it calls into investigation the connection between architects and educators.

This is an issue that is apparent with the poor designs that I mentioned earlier. Binger, goes on to elaborate,

> "…over the past century, beginning somewhere in the industrial revolution, people developed a strong preference for putting things in boxes, making pigeon holes, and

> developing categories or specialties in the name of greater efficiency and higher quality. It seems only in the recent quarter of a century that the tide may be turning back to what has for many become a lost art… the art of working together." (1992)

Binger believes that it is this necessity to collaborate, "As a team, the power of the architect and educator to influence the learning process is bountiful" (Binger, 1992). This obvious connection between architect, educator, and students is important and this must be explored thoroughly in this thesis. Binger leaves us with this thought, "Students, parents, professional educators and the community—the ultimate stakeholders—will have to learn a new language of many dialects and then, by working together, the opportunity for a new paradigm for learning will be allowed to emerge."(Binger, 1992)

Premise Three:
The architectural design must be driven by the specific knowledge.

In any given educational facility, with the exception of specialized facilities, there is a wide variety of different disciplines being taught. This creates an almost overwhelming sense of complexity in the design process. Each need in the curriculum should be met in the best fashion through elegant design solutions. Dudek discusses these needs in an example, "it could be argued that mental arithmetic can best be taught within the context of a small group (of six children) within a dedicated quiet space identified here as a reading room." (Dudek, 2000) Here we see the specific needs of mental arithmetic being satisfied in a simple reading space. This leads to the idea that spaces can satisfy multiple needs, thus simplifying some of the inherent complexity of the education program.

The idea of complex needs being satisfied with simplified, multi-functional spaces seems to be something of a contradiction and must be explored. To flush out this argument I want to examine Dudek's discussion of the layout of a standard middle school classroom,

> "How does one make simplistic decisions about the design of a classroom environment when, at one point of the day, the curriculum implies that the children should be organized on an individual basis and, perhaps ten minutes later, as a whole class? On one hand children should be given a degree of control over the use of their time, their activities and standard of work, and on the other, the curriculum implies a tightening of control of both time and content." (Dudek, 2000)

This suggests that the space that the teacher uses must be as flexible as the teacher but not hinder the performance of the curriculum.

Another issue that appears several times in the context of educational design is acoustic design. Dudek gives us the perspective of the facilities user: the teacher,

> "Given the nature of the performance that a lot of teaching evokes, the designer must respect the needs of the teacher not to be deafened by the noise, or to have to strain his or her voice all day in order to be heard- …Surfaces and materials should be chosen which do not amplify noise. Environments can be devised which calm the raucous verbosity of many school-age children through their calm minimalist

atmosphere."(Dudek, 2000)

Some studies of flexible design of "soft architecture" have been published by Sandra Martin, in the Journal of Environmental Psychology, she presents some very good arguments in the usage of flexible design of class room but her results where most fascinating. Martin notes,

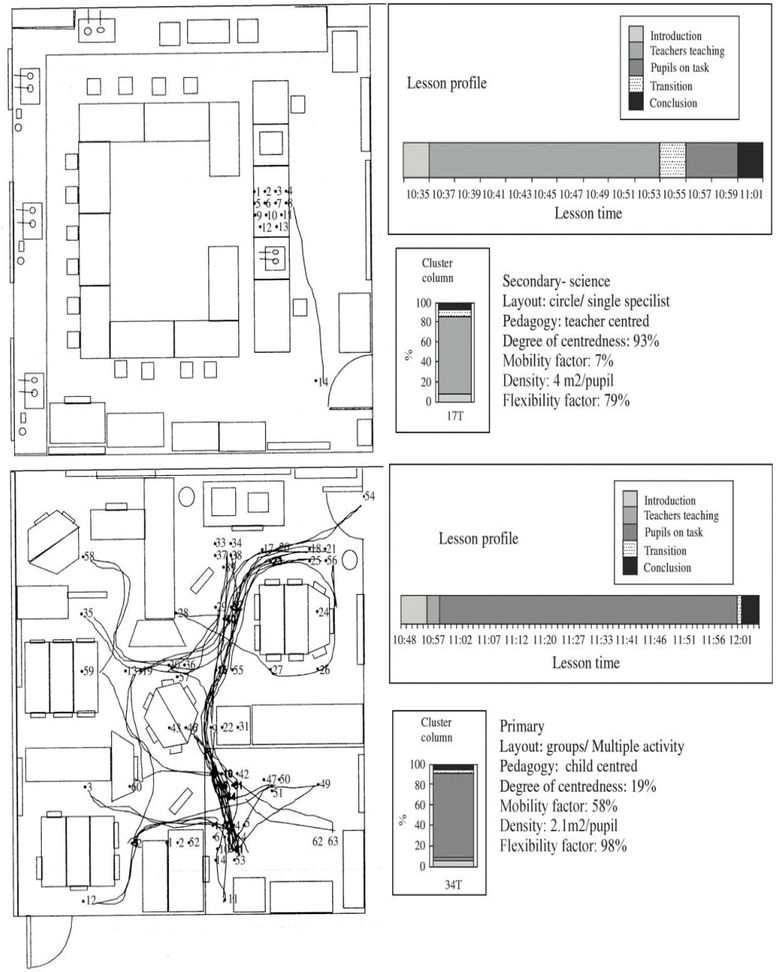
> "The interviews revealed that hard architecture seems to be taken as immutable as teachers seem to be aware that the setting affects their teaching styles and a large proportion of teachers take into account their classroom spaces when planning their lessons. What seems to be controversial among teachers is their perception of control over different features of the soft architecture, mixed and confused perceptions especially when semi-flexible features are concerned."(Martin, 2002)

I also found this passage, from her conclusion to the article, interesting.

> "When I examine teachers' environmental awareness, I could indicate three types of attitudes. I found teachers that do not perceive their surroundings in a constructive way and do not seem to perceive how much impact that setting is having on his/her teaching and class. These teachers, consequently, do not act when a problem arises. I also found teachers who were aware of the impact of the settings on themselves and on the children. Some of these teachers were victims of their own classroom settings, as they knew something was not working well but they could not do anything to find a solution. Then we also find teachers that are aware of their surroundings and deliberately use them. These are the environmentally aware teachers but they are not as common place as ideally we might wish."(Martin, 2002)

I believe that this reasearch reveals that flexible architecture leads to more control over the classroom but can also cause confusion. Martin believes that a professional teacher can utilize these configurations to best enhance the learning experience. Finally, I wish to convey what Stanton Leggett mentions in his book, *Planning Flexible Learning Places,* because it relates to the quality of the users of the thesis,

> "What makes a middle school distinctive? The children it serves. Happily, they are neither here nor there. They've escaped from the mother hen atmosphere of the lower grades, bet that have not yet been captured by the subject matter orientation of junior or senior high school—not yet been subjugated to scope and sequence. They're latterly "between" and temporarily free. Middle schoolers are insatiable learners, too. They're full of curiosity, energy, and joy. They've progressed to a point in their education at which they're ready to learn about such important things as what makes the world tick. For many, their years at a middle school will be the last time that they can walk all around an issue, looking at it carefully. Once high school subjects specialist take over, learning quickly becomes abstract. In short, middle schoolers are turned-on kids. The task of their schooling is to capitalize on their energy and freedom by keeping them that way. To do that, we must recognize that exciting, imaginative ideas and curricula require new models and new ways of thinking about "traditional" learning patterns. No longer can we assume that the best way for children to learn is by moving from the simple to the complex. Motivation, not linear organization, is the prime incentive. It's easier and more exciting to learn to read when children have a goof reason of their own to learn than because school simply says that they should."(Leggett,1977)



It has been said that the children are our future. Then it should be of the utmost importance that they are provided with the best environment to attain the most important tool possible: an exceptional education. It is evident that recent educational architecture has not been keeping this in mind when inefficient schools have been repeatedly constructed over the last century. This shortcoming needs to be addressed immediately; unfortunately there is not a simple solution to this endeavor.

There are, however, changes that have been taking place over the last few decades that hope to amend this; they comes from a desire to understand the multitude of complex issues that occur in educational design. It is my claim that through thoughtful design, architecture can be crafted into an environment that best allows one to attain specific knowledge; I hope to further my understanding and address these concerns.

In today's education facilities many different disciplines are taught to the youth or anyone who seeks knowledge, these seekers are infinitely different in their learning habits. This compounds the complexity when viewed in the built environment but the complex program of education is a something that needs to be addressed if one wishes to design a highly-effective learning environment. The diversity of intricate environments that need to exist in an educational facility needs to be understood and addressed by a professional: an architect. An architect has the training that is required to best grasp the complicated nature of the education program and thus design the best solution to satisfy those needs. The layperson simply does npt have the training or responsibility (legal or moral) to deal with these variables.

Education, like much of our society, has been transformed by industrialization, and the aftermath is most evident in the constant trend of specialization. Architecture has fallen victim to this as well; architects sometimes tend to design without taking into consideration the user and design for design sake. This trend cannot continue if one wishes to design successful education environments. It is paramount that the users are taking into consideration form the inception of the project. The teacher's experience needs to be utilized to craft an efficient learning space. Collaboration between architect, teacher and student are essential to an effective design.

The knowledge that is being fostered also needs to be considered when designing. Consideration to the nature of the subject and the student being taught should be made on both a macro and micro scale. Not only does each environment have to meet the individual's specific needs but also the instructor's needs to effectively allocate the given curriculum. This creates something of a paradox: simplified spaces that satisfy a multiplicity of different usages. It is up to the designer to creatively translate these needs into an elegant and efferent space.

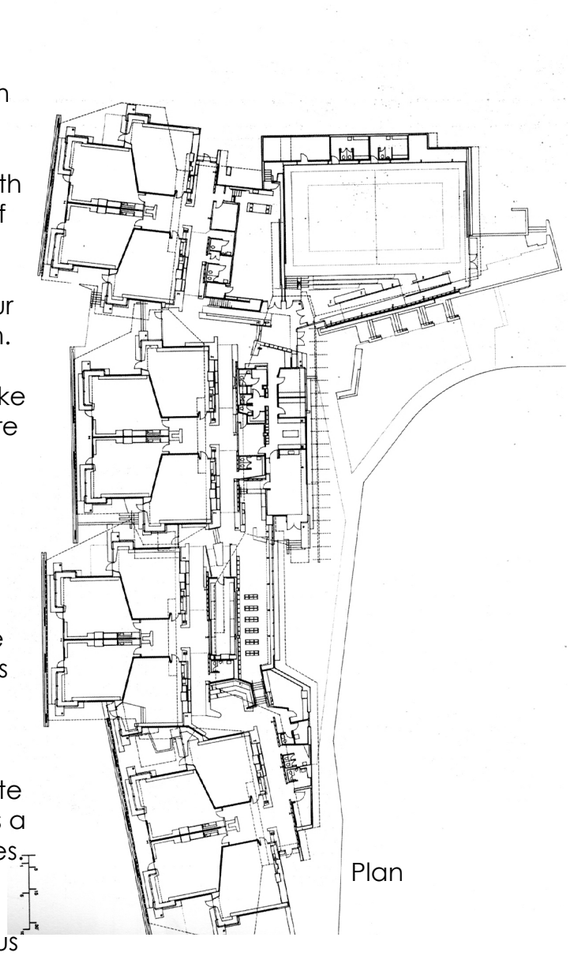
There is an unattributed saying, "Insanity is doing the same things over and over again and expecting the different results", this is especially true about educational design; one cannot continue designing this way and expect our children to perform better. I hope to take what I've gathered here and proceed to design an educational environment that better addresses this multiplicity of concerns in an well-designed way. I believe that this is an ambitious goal, but things that are easily done probably is not worth doing.

Typological Results

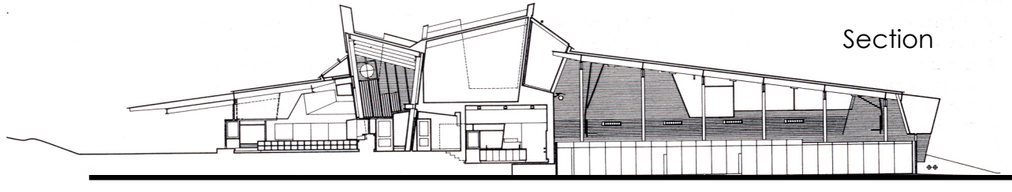
Case Study One:

Strawberry Vale School is an elementary school in Victoria, British Colombia. This building is 34,000 ft² and constructed with timber and steel structure and is nestled against a forested hill. The facility can accommodate five hundred students with ages ranging from five to eleven years of age.

The building is made of five parts: the four classroom segments and the gymnasium. Each classroom segment consists of four different classrooms that are arranges lake a small rustic house. All the classrooms are orientated southwards towards the oak forest away from the urban environment that dominates the northern vista. This choice to deny the urban view and embrace the naturalistic view was obviously a conscious decision in the design; these classrooms segments share mezzanines with their adjacent segments creating a space to interact with this natural environment. These shared outdoor spaces create a commonality between classrooms that form an intimate learning environment that, in turn, fosters a sense of community with the other classes. The teaching equipment that is used in the class room space is mobile so that it could be brought to the outside area thus bringing the class into these mezzanines, this this the product of flexible class room design. The connecting circulation spaces weaves in response to the classroom segments and this eliminates long corridor views; this segmented passage also creates private spaces that provide perfect break-out rooms.



Plan



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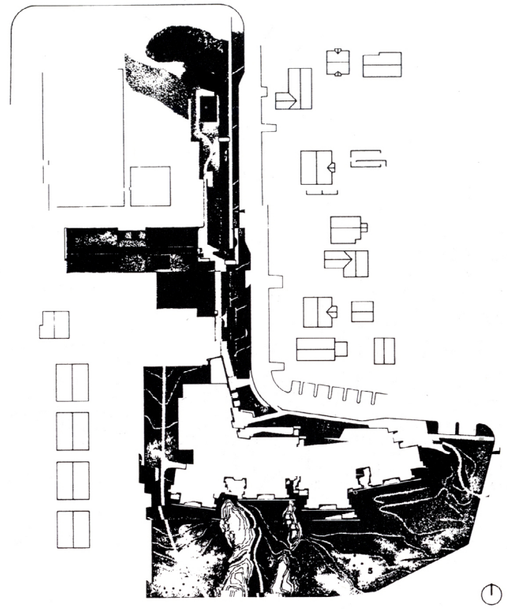
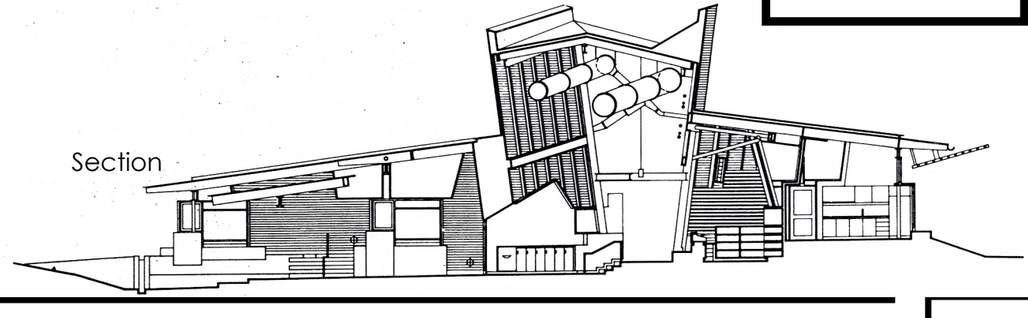


Site Plan

With naturalistic views and timber construction it is clear that the architect wishes to endow the building with a rustic feel in intimate space but also with the steel and white painted gypsum finishes crate a complimentary modern aesthetic. The consideration for natural light is also quite evident with the usage of clerestories, windows and roof lights, these features optimize day lighting and enhance the rustic/modern nature of the building.

This case study, more than the others, demonstrates a control over the arrangements of the class room spaces. The staggered arrangements of the classroom segments create many unique arrangements that affect the nature of both interior and exterior spaces. This project masterfully addresses the need of the students and site perhaps better than the other cases. However, the integration of the gymnasium doesn't seem to carry the thoughtfulness of the classroom design however the exterior conditions do react well to the ram that exists in the gym space. It is the largest of the studies but it still creates an intimate and rich educational environment. (Dudek, 2000)



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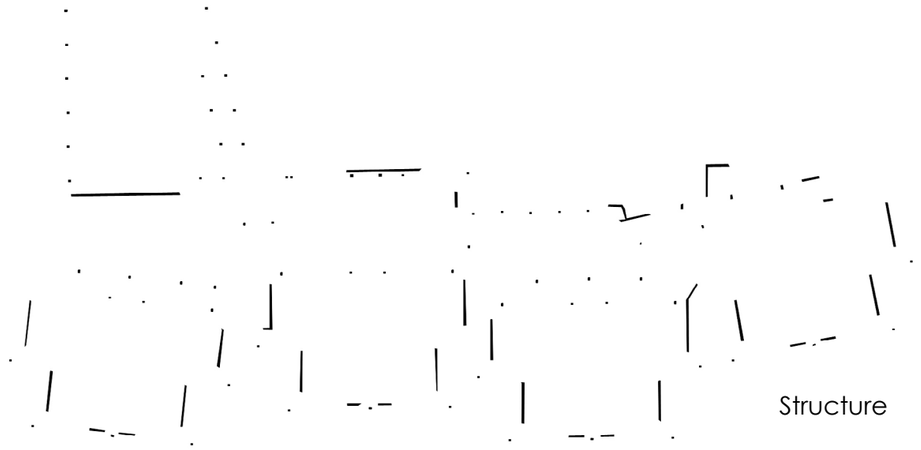
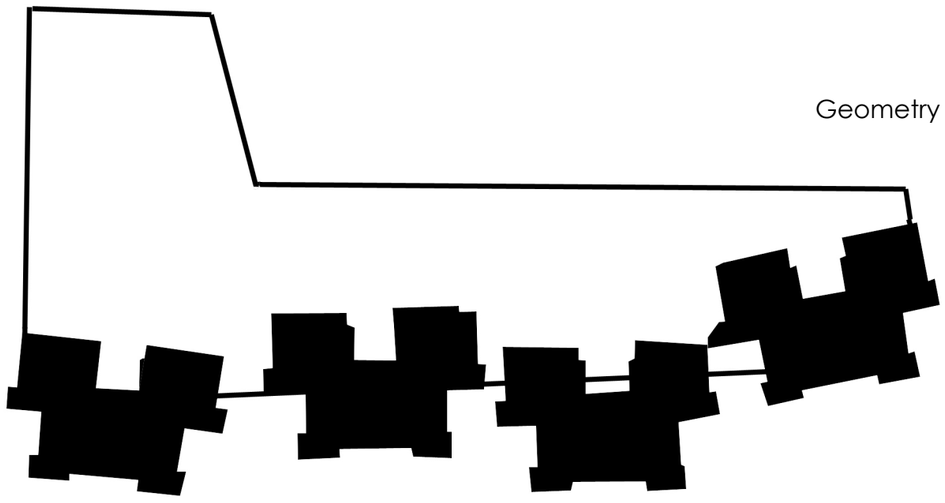
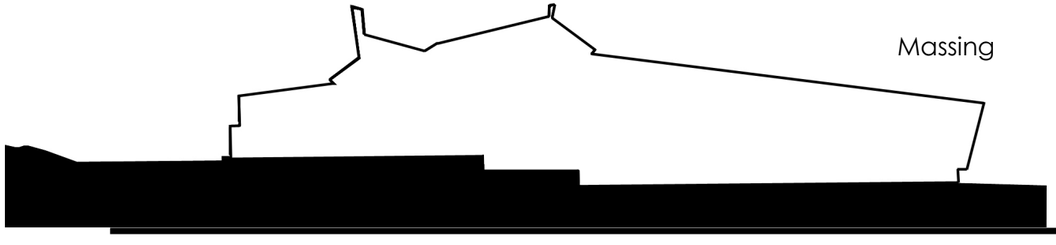


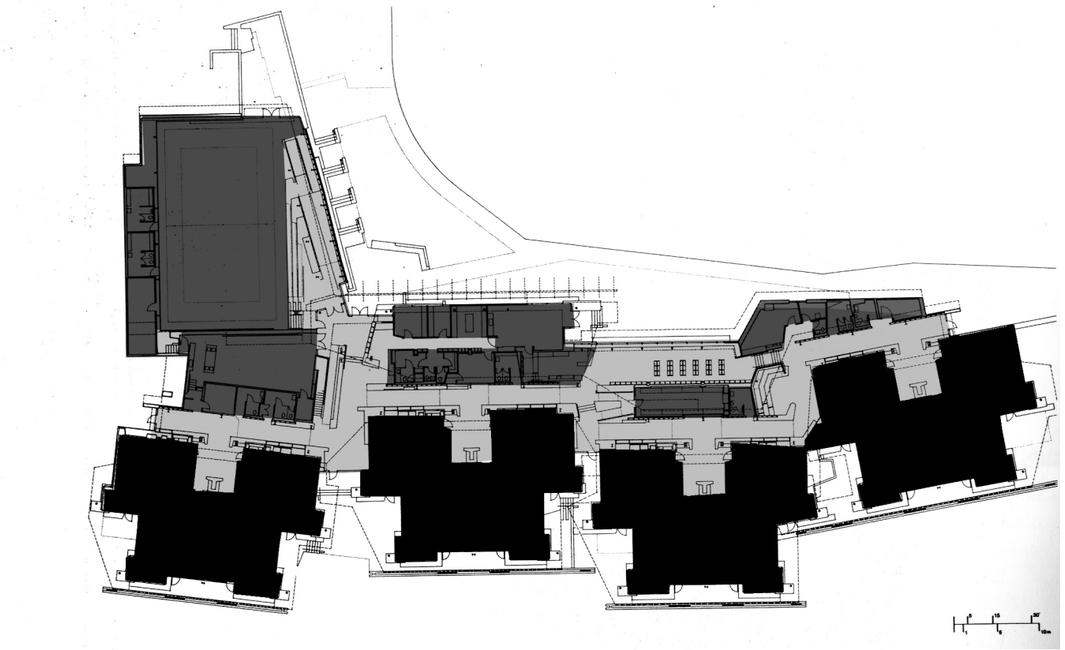
Structure



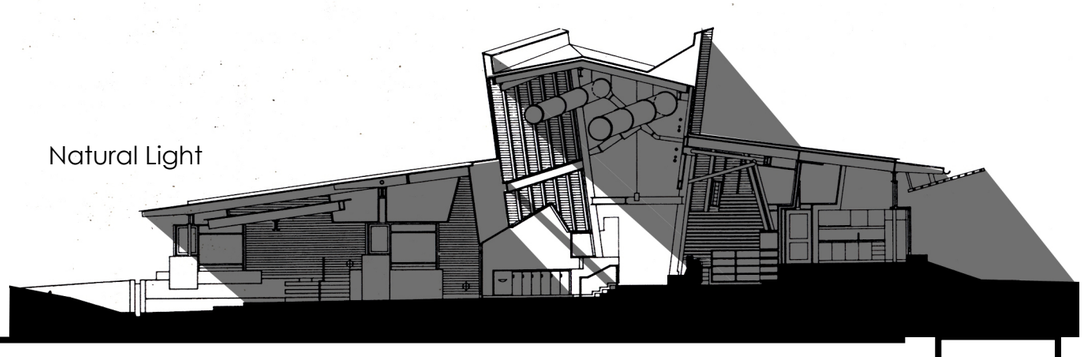
Geometry



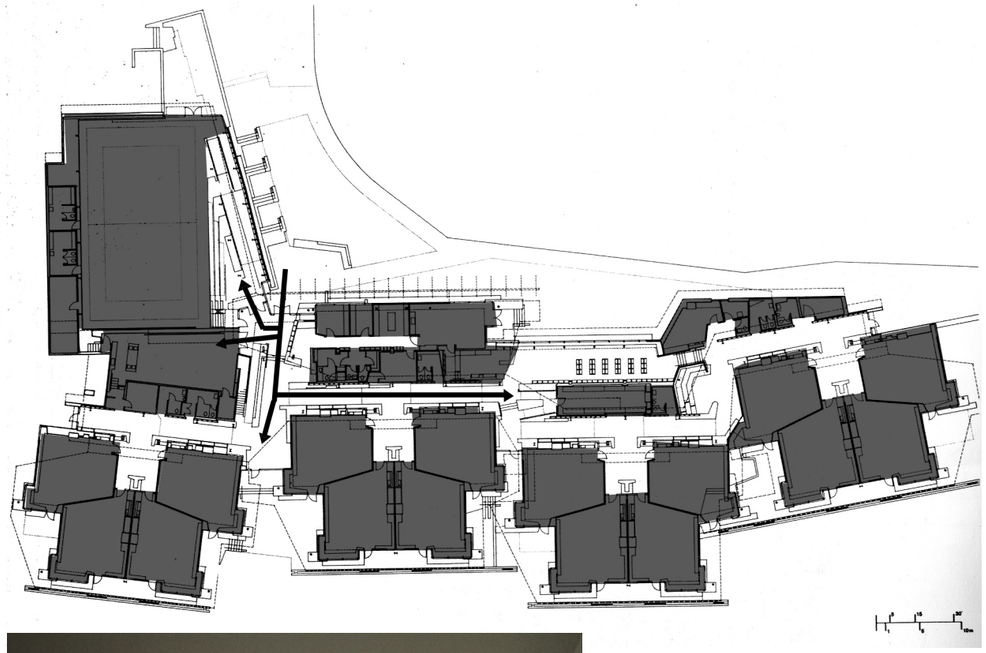
Massing



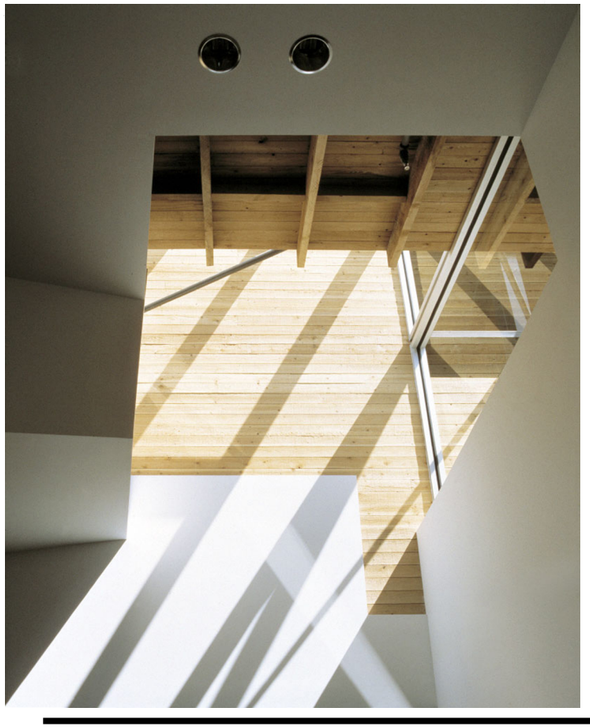
Hierarchy



Natural Light



Circulation to Space

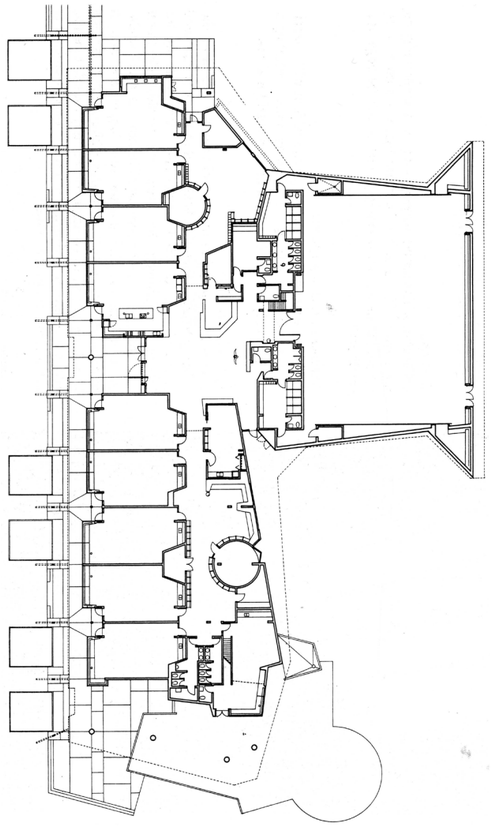


Plan to Elevation

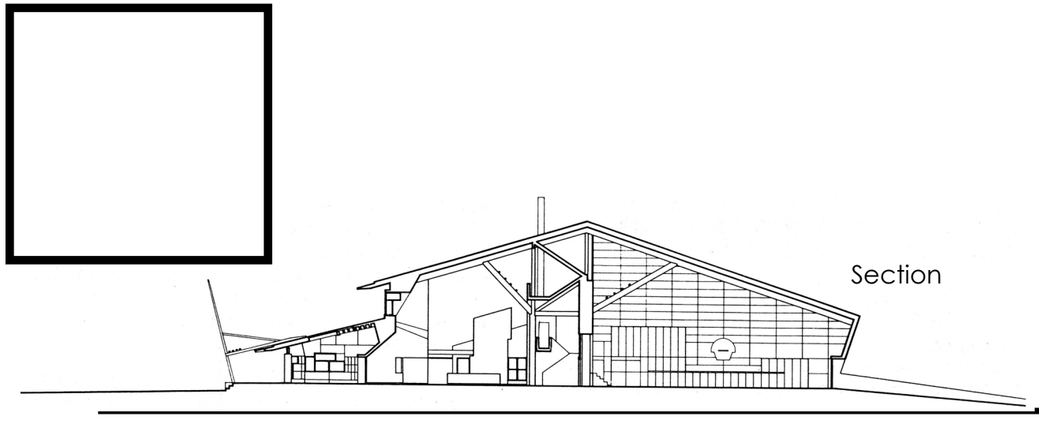
Case Study Two:

The Seabird Island School in Agassiz, British Colombia is an elementary and middle school that houses four hundred students. It is a 23,000 ft² facility constructed with heavy timber post and beam with steel connection that reflects the native Canadian Pacific Northwestern tradition. The school is situated on the edge of an existing village square but still has a 3,300 ft² dedicated play area. The building consists of ten class rooms that are grouped into clusters of two; these clusters are facing south to optimize solar gain in this frigid climate and the gymnasium is situated on the north to act as a buffer against the cold prevailing winter winds; the large protective gymnasium roof deflects the cold mountain wind that travels from the north. The building itself protects many other buildings in the village.

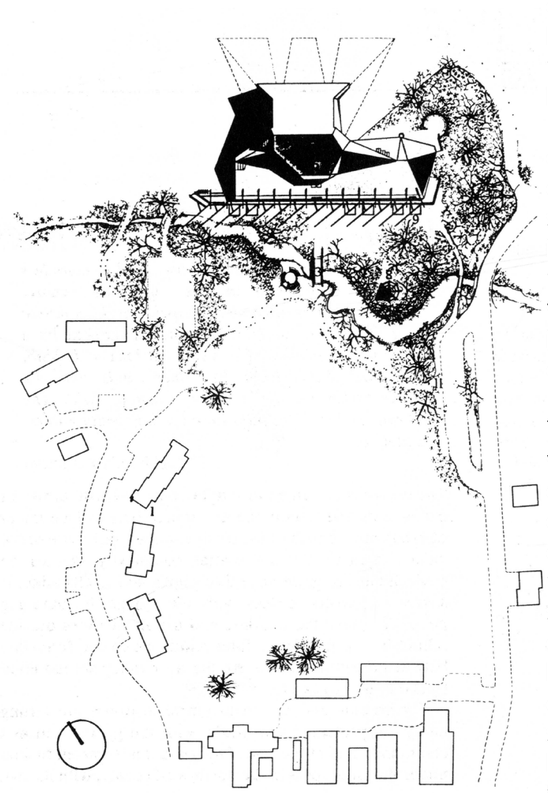
The classrooms are clustered in a repetitious fashion creates a sense orderliness but that is contrasted with the large open ceiling in the circulation corridor. In this corridor runs along the center of the building dividing it between private and public; the linear quality of this corridor is interrupted with the introduction of curved forms that break the long view of the corridor.



Plan



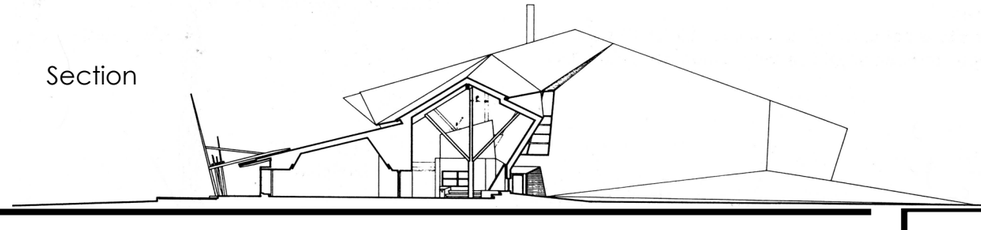
Section



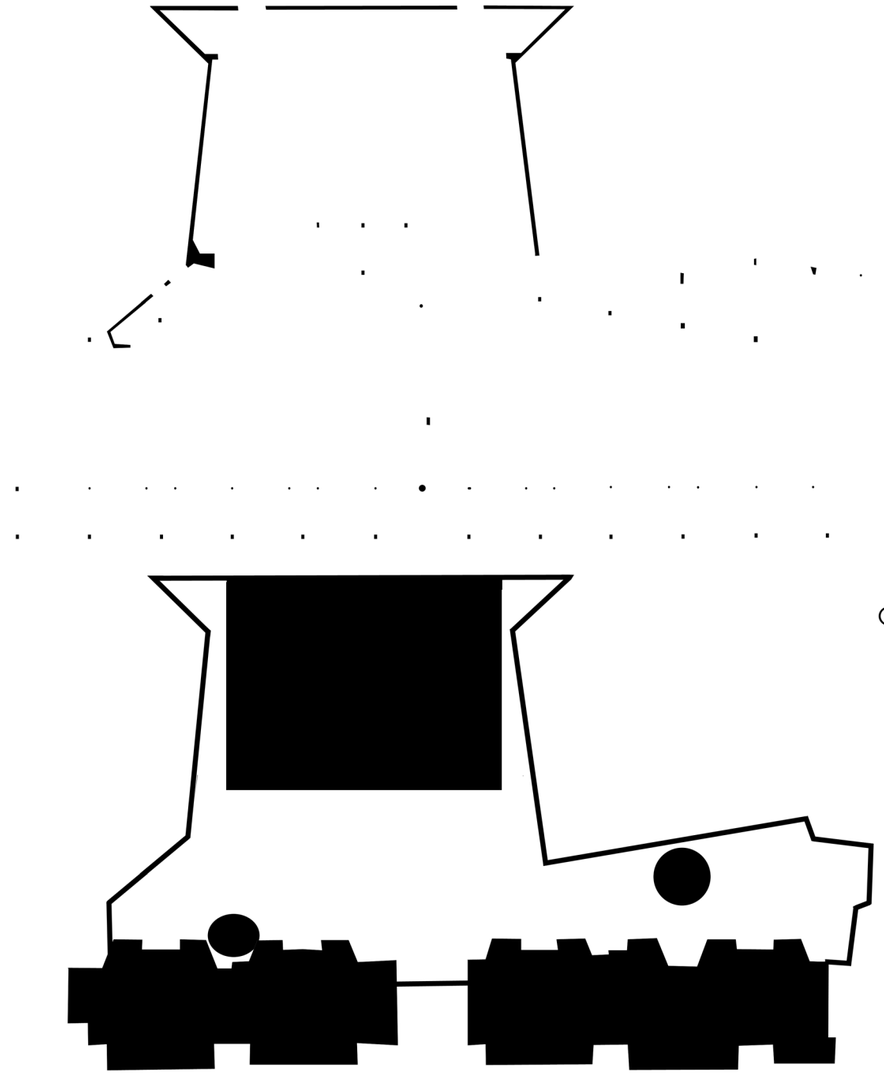
Site Plan

This particular school was designed the client's culture in mind; firstly it was constructed in the tradition of village with heavy timber construction. The majority of the timber structure was actually erected by members of the community; a large 1:20 structure model was made to aid the amateur builders. There are other cultural elements worth mentioning: a fire pit and salmon drying racks were implemented into the design as well as an outdoor teaching garden. These elements, along with the school itself, are evident of the integrated relationship it has with the community.

The Seabird Island School's integration with its community is unparalleled compared to the other case studies not only in its location in the village but also its construction method and utilities that aids the community; this building has become something of a center for Agassiz. The open nature of it linear corridor pulls in light like the Strawberry Vale School; both cases also group classrooms that allow for shared outdoor activities. Both also utilize large shading structures on the southern face of the building and large protective roofs on the gymnasium. These two cases also share the same geographical region of southern British Colombia, it is interesting to see both are so similar in configuration yet one is in a small village and one's in the capital, Victoria. (Dudek, 2000)

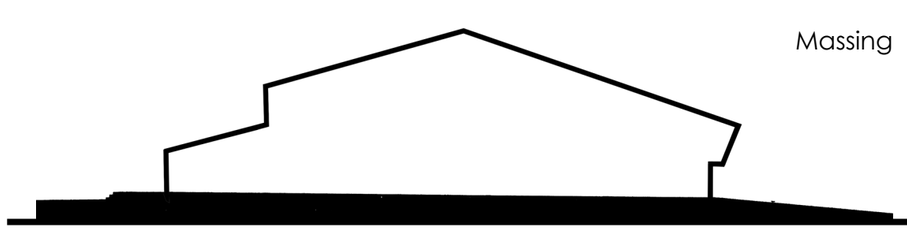


Section

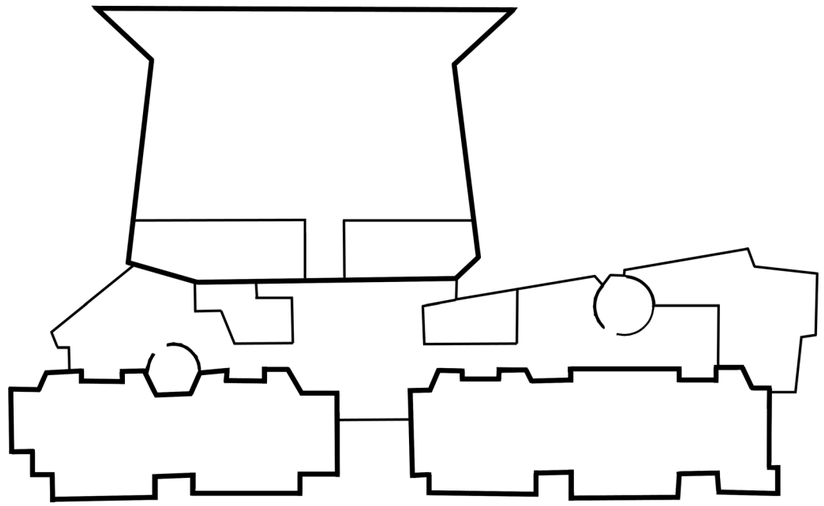


Structure

Geometry

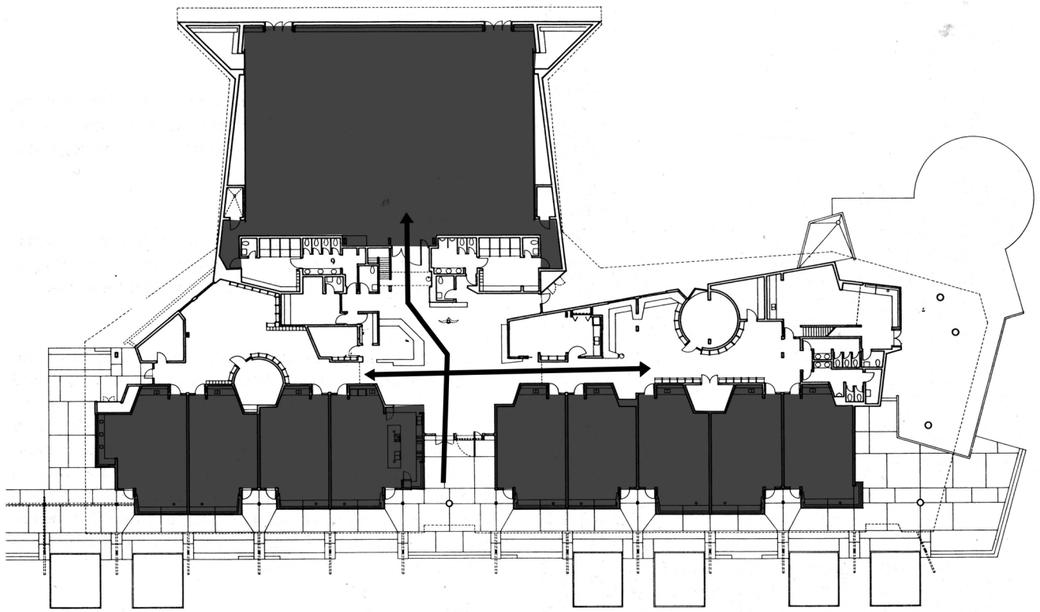


Massing

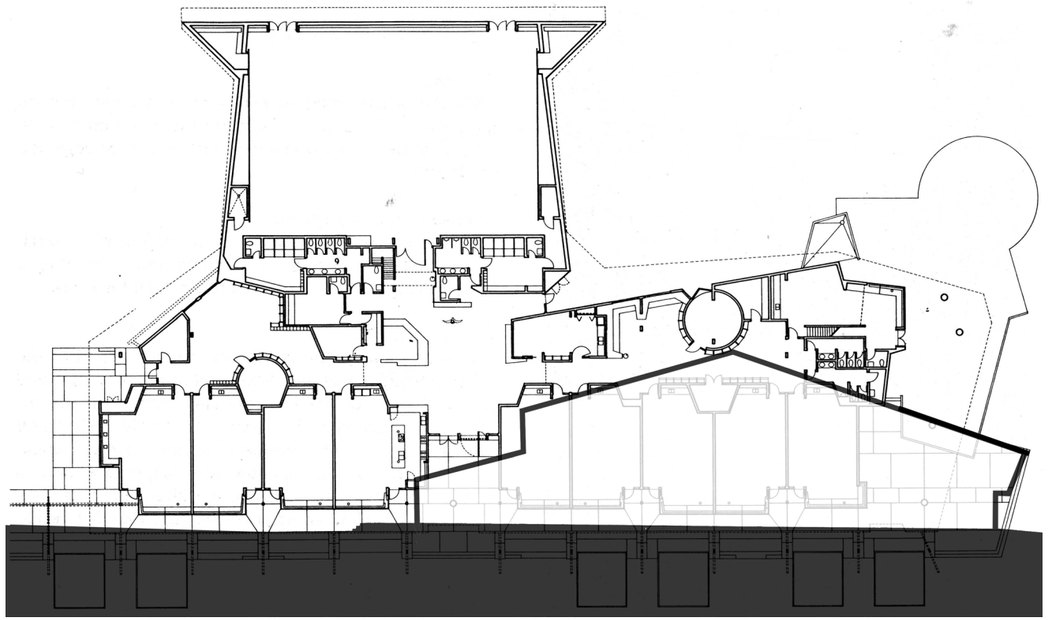


Hierarchy

Natural Light



Circulation to Space



Plan to Elevation

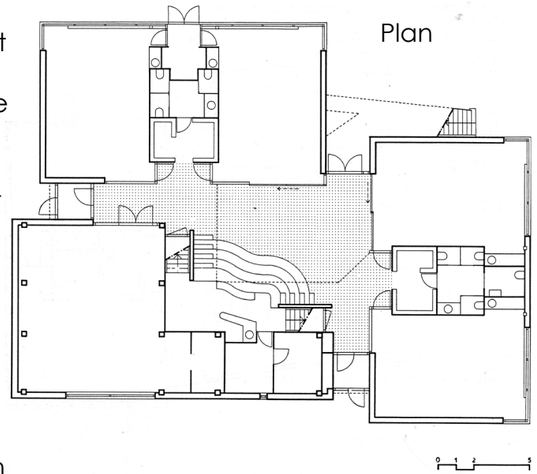
Case Study Three:
The Anne Frank School is a school in Papendrecht, The Netherlands, it is 4,000 ft² three story steel framed building. It is designed to school five hundred, four to twelve year old students in eight classrooms. The building sits on an 8,900 ft² flat site on the edge of a modern housing development that is encompassing a large residential community. This educational facility I unique because it takes a vertical organization with its spaces verses the traditional layout.

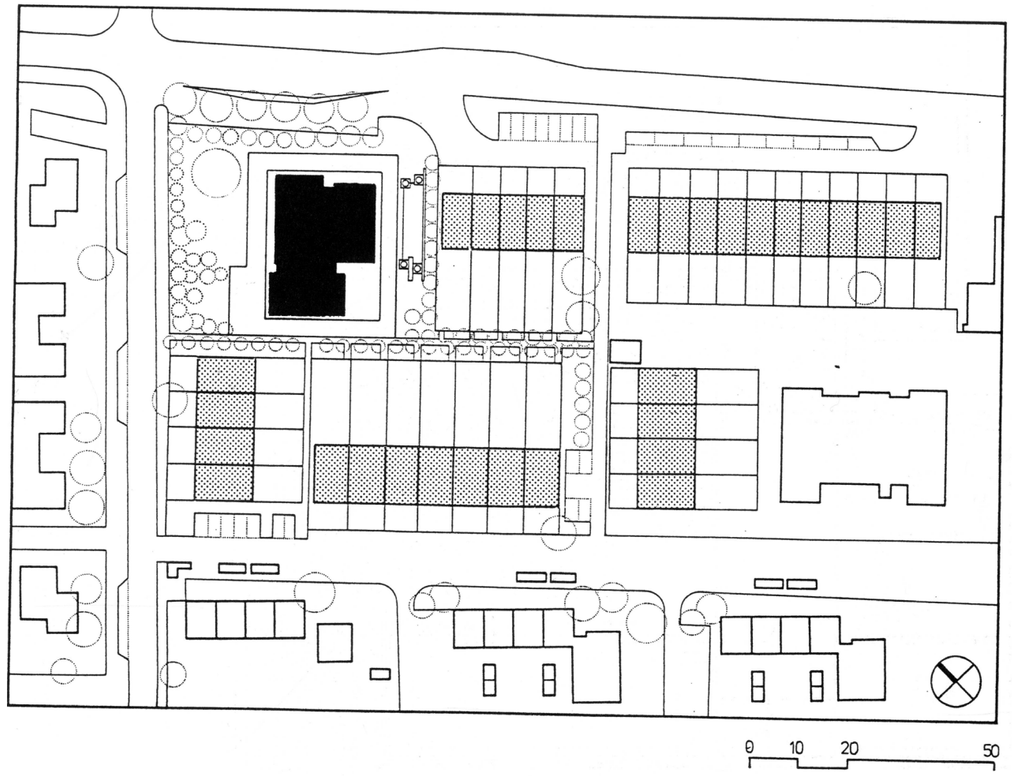
The vertical nature of this building allows some for some very interesting occurrences. Firstly, the center of the building becomes an atrium that allows students to experience different special views as they move throughout the vertical space. The arrangement of stairwells offers alternate routes through the building making travel from class to class different and engaging to the students. Not to mention the ability to control the heat envelop with the vertical organization of spaces is always an economical factor. Another interesting feature is the lack of security in this facility. It is open all day and most of the evening for parental usage. It has three entries on the main floor with unlimited entry, this may be a concern but this is one of the reasons for the open vertical design, there is a lot of exposure on the ground floor and this allows many people to easily monitor the place, this helps discourages intruders.

The class rooms are sectioned into group of two with two groups per floor and a larger classroom near the main stairwell. These groups sandwich a shared bathroom and cloakroom; this gives the sense of interconnection between classes. The classrooms are an open arrangement that allows for flexibility for the instructor. On the top floor are offices and staff rooms, this is quite different from traditional arrangement because it distances the staff from the main entry.

This case study differs greatly from the others not only in its geographical region but also in its overall configuration. The Corbusian style of white walls and horizontal ribbon windows contrasts greatly from the rustic quality from the other studies. The Anne Frank School's vertical organization is not only vastly different from Strawberry Vale or Seabird Island but from many traditional school layouts. This case doesn't allow for students to migrate their class to an allocated outdoor space. Despite their differences they all contain flexible classrooms that can configure into multiple layouts to accommodate different subjects. They also take the surrounding communities into account, Anne Frank School responds to the modern aesthetic of the surrounding residence and the interaction with the parents seem to manifest a sense of community; something every school in these studies do well. (Dudek, 2000)

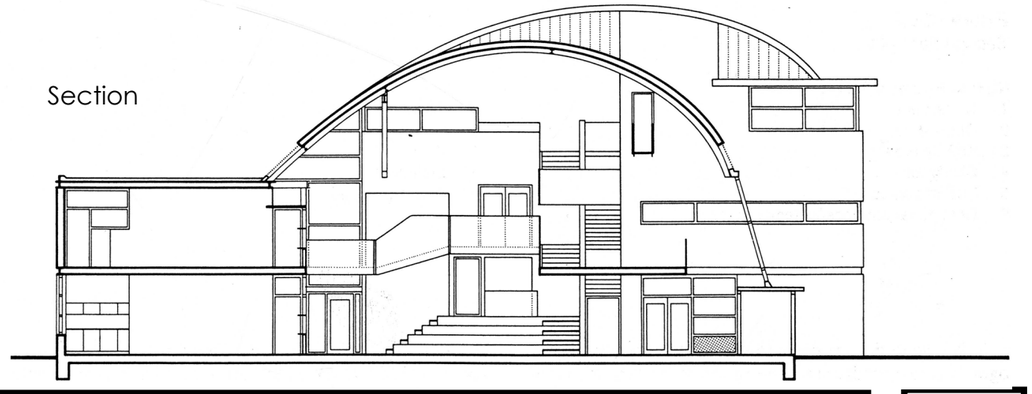
Plan

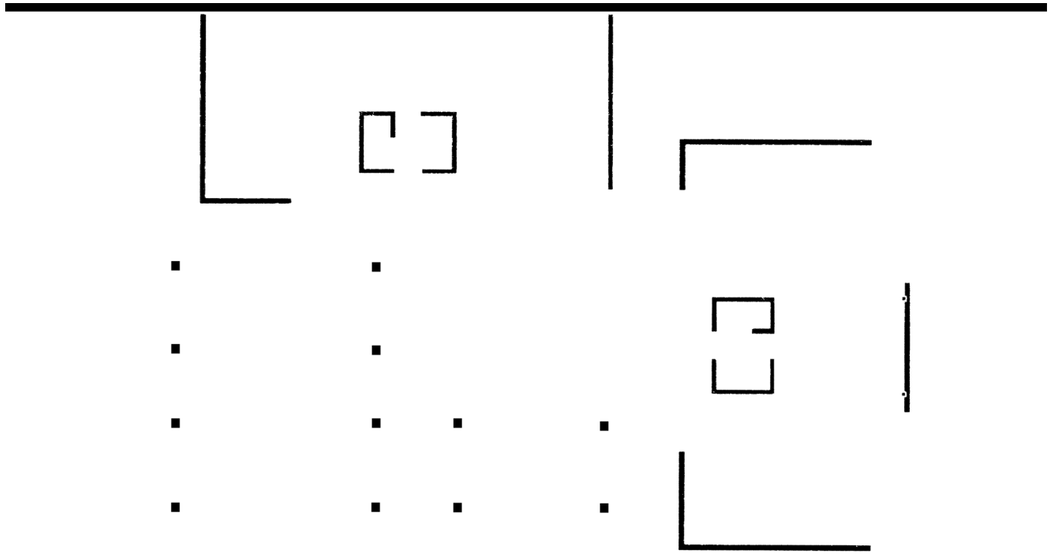




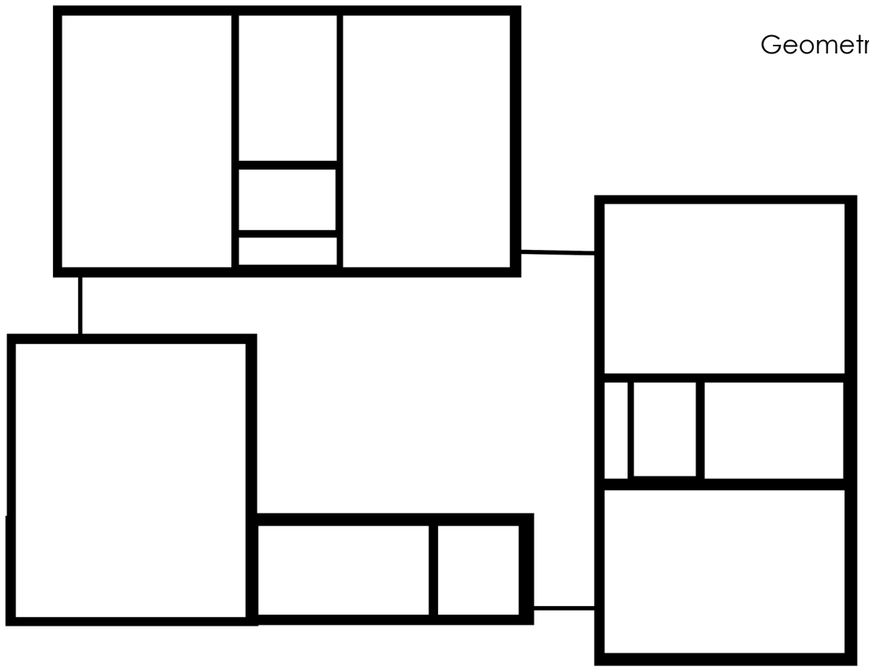
Site Plan

Section

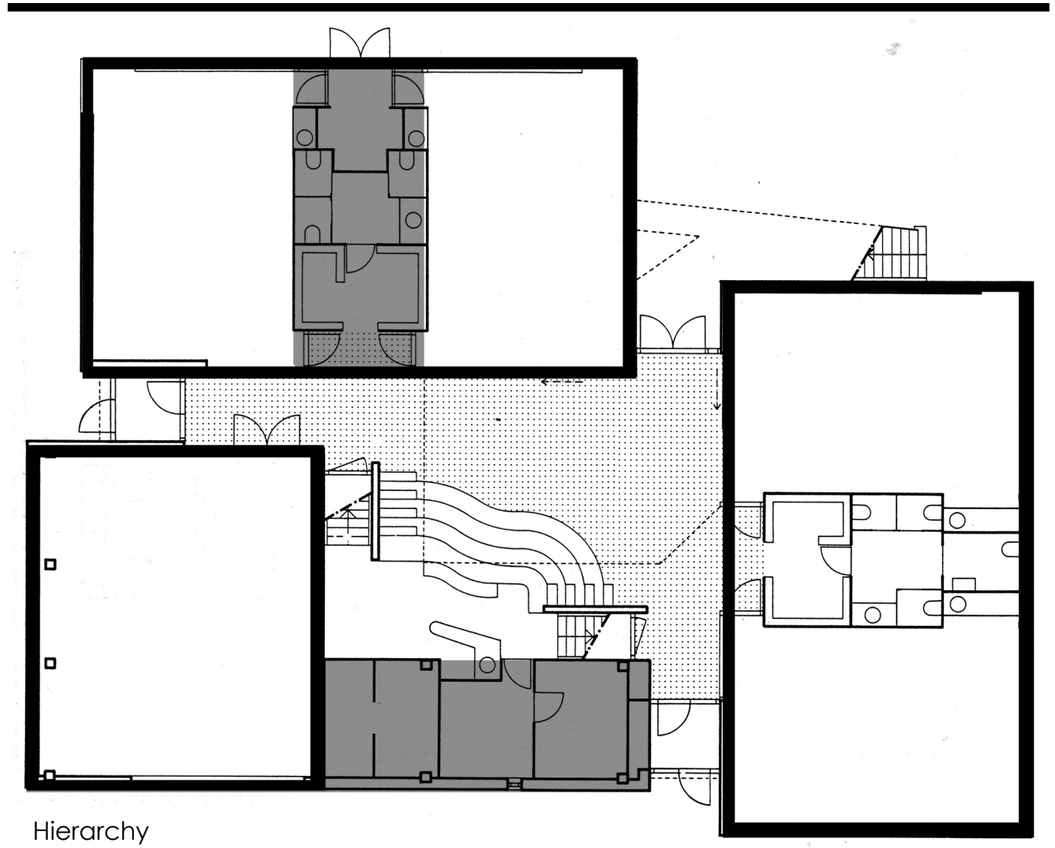




Structure

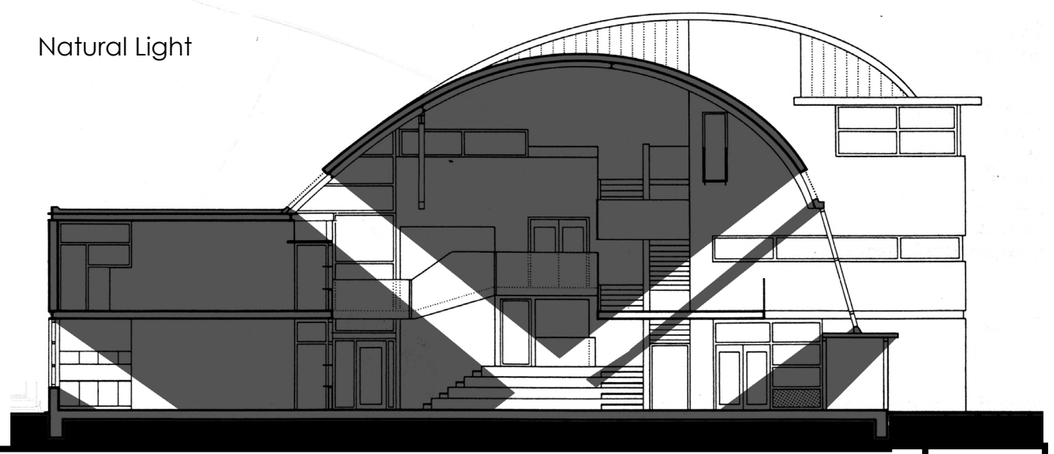


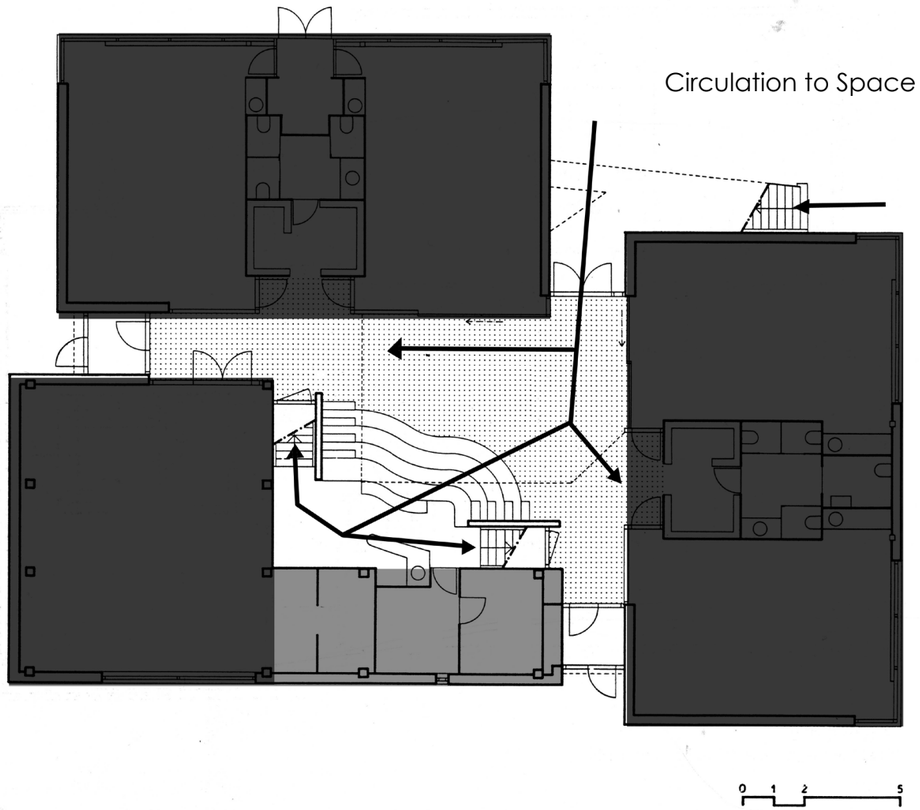
Geometry



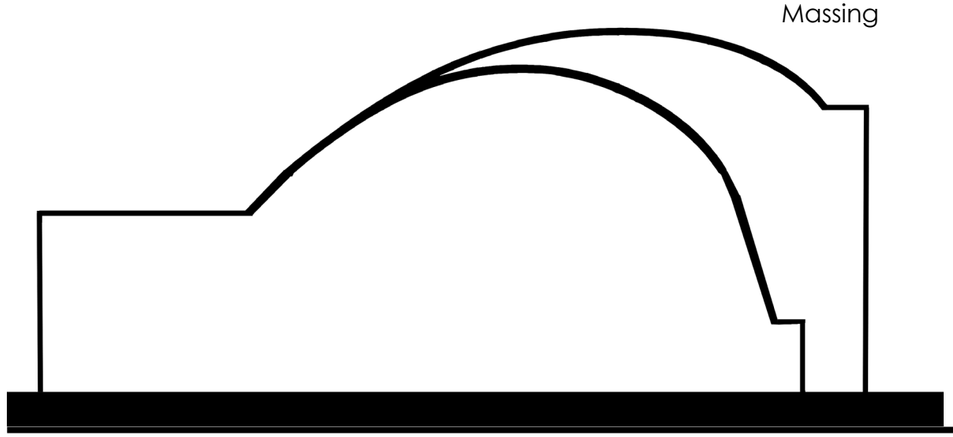
Hierarchy

Natural Light

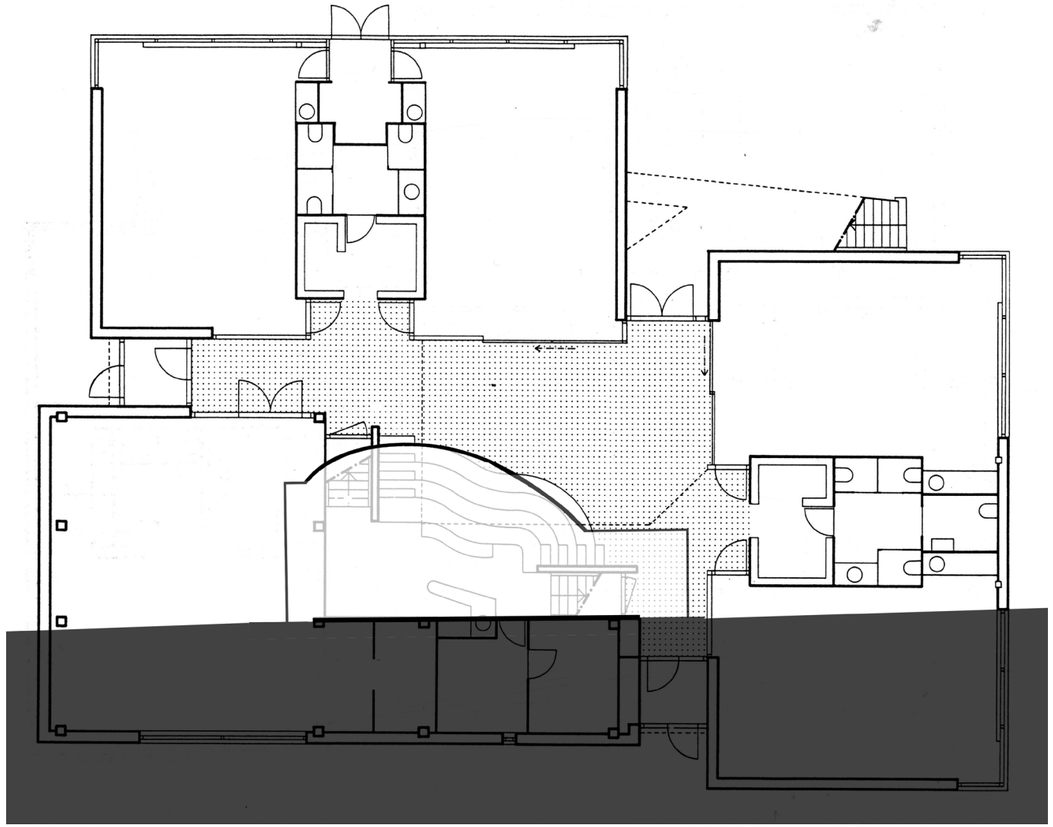




Circulation to Space



Massing



Plan to Elevation

The case studies that were taken into consideration varied in scale, social context, materiality, design methodology and geographical location but they all served a very common objective: the education of children. There were three case studies that were chose: Strawberry Vale School, Seabird Island School, both located in British Colombia and the Anne Frank school of The Netherlands. Perhaps one important thing to note is that the chosen case studies are all outside of the United States, this was unintentional when selecting them but it may be a significant occurrence. All of these projects bring different levels of creativity to the site and program that is evident in their design and solutions that can occur in the complex program that is the education curriculum. By esearching and analyzing these cases it becomes clear that great consideration and collaboration with the users (teachers, students and the community) is necessary to craft an environment that fosters learning; this reaffirms the Theoretical Premise of this thesis.

Through the analysis of these cases it becomes clear that the organization of classrooms tends to be grouped together and act as a unit and they are the primary concern when arranging spaces in a school. After the class-units are arranged then the priority becomes the path to the class-units; everything else in the program is arranged around these two important factors. The forms of the schools also react to the environment to allow natural light to become a part of the classroom and conscious placement of the buildings to allow passive heating/cooling strategies.

The most common design decision that was prevalent was, as mentioned

The most common design decision that was prevalent was, as mentioned above, the collection of classrooms into units.This is intriguing because it creates a community feeing in these spaces, this sense is compounded when they share a common space such as an outdoor portico exemplified in the Strawberry Vale and Seabird Island schools. It also important to note that all of the class rooms have an open floor plan that allows for flexible management of class space. This is useful when dealing with the complicated curriculum in schools. Another commonality that all the case studies displayed was the open ceiling that occurred in all of the circulation spaces; this is enjoyable because it contrasts the focused environment of the classroom. The strength in these designs is the attention that they spend on the classroom environment and circulation this is apparent that they value the instructors and children occupying these spaces.

The Strawberry Vale and Seabird Island schools shared many similarities in design so it is understandable that there reactions to the climate and culture are similar but the Anne Frank School in the Netherlands takes a different approach, it is a vertically organized school and this is very uncommon for an elementary school. This may be attributed to the site it was located on: a modern residential development.

All of these cases take into account their site and culture through materiality and special organization but they all share the same function: education. As different as these buildings are they still focus on the classroom experience and the path to the classroom. These are clearly important to the design and rightfully so.

The site determines form, materials and how the community interacts with the building but it ultimately comes down to is focusing on crafting a quality environment for children to learn.

Historical Context

A small but hardy seed was planted in a fertile garden. This garden in all its bounty lay in a vast valley that ran far into other lands. This valley is also situated at the bottom of an ancient lake that disappeared 100 centuries ago, before that, this particular valley was covered in mountains of ice. But no longer, now it is a green valley. The valley is the border between a vast green hill-land and titanic flatlands seem to stretch so far into the west and the sun would crash into it in the evening; beyond the great plain lay a mountain range that denies all's passage. Before time in memoriam, the land was occupies by nomads that lived off the beasts of the land, these beasts were innumerable and covered the land as far as the eye could reach. The nomads dwelt in this valley until 210 ago. At this point of history the valley came under jurisdiction of a once far off nation; this nation was the United States of America. The citizens of this nation crossed the hill-lands and eventually drove off the nomads; they settled in the fertile valley and established a settlement on the crossroads of a newly built railroad that stretched across this nation and the river of the valley, the Red River. This settlement is the seed that would eve ntually grow into the city of Fargo.

Fargo's beginnings is in fact rooted in the railroad, as told by John Caron, Institute for Regional Studies, "It was generally conceded that the point where the railroad crossed the Red River would arise the next great city west of Minneapolis & St. Paul, which each had a population of about 10-15,000 at the time" (Caron, 2009). The person who was responsible for deciding was Thomas H. Canfield; this is elaborated further by Caron,

> "Canfield (President of the Lake Superior and Puget Sound Company, a town site company auxiliary to the Northern Pacific) worked with railroad engineers to select a site for the railroad to cross the Red River. Their work was held in strict secrecy to thwart land speculators. There was a tradition among the Indians (corroborated by Hudson Bay Company employees to Canfield) that the Red River overflowed its banks and the whole Red River Valley became a sea in the spring. Canfield and Wright spent some time that spring going up and down the river searching for high embankments upon which to build a railroad bridge to cross the river. Canfield and Wright decided that Moorhead was the highest point as far as they could determine without instruments". (Caron, 2009)

This was the deciding factor that dictated where the railroad would go; the town that sprung up was then officiated, "On October 6, 1871 a post office was established at the site and the town given the name of Centralia."(Caron, 2009) But Canfield soon wrote to the post office that the settlement on the west bank of the Red River was to be named Fargo, after William G. Fargo, a partner in the Wells-Fargo Express Company. So it came to pass that the township was renames, "On February 14, 1872 the United States Post Office officially changed the post office name to Fargo." (Caron, 2009)

"In 1876, Fargo's population was only 600. But Fargo grew rapidly as more and more settlers arrived, drawn by the promise of cheap, fertile farmland in the Red River Valley. By 1892, Fargo had grown to a city of more than 8,000 inhabitants; the tents and shanties of earlier days had been replaced by mainly wood-frame buildings. But on June 7, 1893, disaster struck the growing city. A fire began on Front Street (now called Main Avenue). Fanned by strong winds from the south, the fire consumed most of the downtown area. By the time it was over, more than 31 blocks were reduced to piles of rubble. Although the fire must have been a stunning blow to the city, Fargoans resolved to rebuild; in less than a year, 246 new buildings had been constructed. The new structures were designed by many fine regional architects; the post-fire city became more attractive and substantial, and many of these buildings survive today" (Caron, 2009)

Taking a step back, it is important to look at the educational facilities and how they developed in Fargo, John Caron recalls the early beginnings of Fargo's educational system

> "The first school session in Fargo was held in the summer of 1872 (reportedly in a log cabin in the vicinity of what is now Island Park). Mercy Nelson (age 15) was the teacher. Ms. Nelson was to become Mrs. Eben W. Knight of Lisbon, ND. The next school appears to have been held in a hall at the corner of Fourth and Front Streets with Miss Alvira F. Pinkham as teacher of 15 students… In one of the earliest records, A. McHench, Cass County School Superintendent reported in November 1874 to the Dakota Territory Superintendent of Public Instruction that Cass County had organized one school district [Fargo] six months previously and had a school house that that would accommodate 76 scholars. McHench reported that Cass County had 27 males and 36 females between the ages of 5 and 21 years, of which 17 males and 24 females attended school. McHench also reported that the school term was three months long and was taught by Miss A.M. Giddings, who was paid $45 per month".(Caron ,2009)

These vernacularly designed school houses dominated the Fargo are until after the turn of the century.

The development of the educational system and school design near the turn of the century. The current trend, in 1972, Edward Robson wrote in his book, School Architecture, "…so that his book, like many manuals of the time, was little concerned with the external architecture style chosen for schools. Kendall and others were architects but not educationists and showed themselves only marginally concerned with matters of internal school organization." (Robson, 1972)

In America, the educational system underwent a change during the first part of the twentieth century, Mark Dudek explains in his book, Architecture of Schools: the New Learning Environment, that Frank Lloyd Wright's influence on school design was quite profound,

> "The Prairie House formula applied Dewey's views on flexible multi-functional spaces and harmony with the natural environment for the first time. It demonstrates the suitability of such thinking in education and, in 1902, was widely recognized as the most advance school form of its type. Built at a time when most school design was essentially based on historicism. Wright's interpretation of Dewey's philosophy illustrates a flowering of architecture for school in its integration of two radical new philosophies, one educational, the other spatial. Subsequently it was much copied, but never with such architectural dexterity" (Dudek, 2009).

Dudek goes on to remark the qualities that the Prairie House design possessed that made it a better learning environment.

> "Wright, with the aid of Dewey's prompting, had invented a new form of school architecture; one which was not confined to a restricted urban site. Rather, it opened itself up to the surrounding green spaces illustrating the positive benefits of rural settings or what in later years might be characterized as suburban. The classroom vista was no longer restricted by high window sills with children stiffly focused on the teacher sitting on a raised dais. Instead they were encouraged to use the surrounding context as a catalyst to creative thought and activity, all on the same physical and social level as the teacher. Furthermore, the architecture developed in response to its setting, which was used to compliment and inspire its design." (Dudek, 2009)

In Fargo, the schools that were developed still strongly influenced by vernacular design; predominantly being built with wood construction but as the population increased, more schools were built. Then there was the fire of 1893, after this disaster most of the schools where constructed from stone and masonry. Most still built in the vernacular style but it wasn't until 1911 did elongated, Wright inspired design start appearing with the Agassiz school, which is located at 1305 Ninth Avenue South. The trend of masonry construction in Fargo shifted to steel construction but most schools are still has masonry cladded façade. There are currently 31 elementary, middle, and high schools in the Fargo city limits and 14 in West Fargo.

Goals of the Thesis Project

he issue of proper school design has been debated subject in the architectural academia ever since the formalization of public education that manifested itself during the industrial resolution. Since then, schools have ranged from rigidly organized lecture halls to Frank Lloyd Wright inspired Prairie House Style. With the mentality that sprang from industrialization, which is everything can and should be compartmentalized; we saw a legacy of educational building born of this mentality. Schools developed into a repetitive form that resembles simple extrusions that simply satisfies the minimum requirements for basic education to take place. It's in the last quarter of a century that architects have started talking a closer look at the actually activates that take place in a class room to help generate the design. It's this focus on user's activates that this thesis will explore.

When it comes to the process of design of an educational facility there are many factors to examine. Some of these issues are quite obvious, such as safety but then the design become about satisfying the requirements set by the client. This is a gross mistake. The primary objective of a school is to educate the students well and this cannot be done if the facility was designed only to meet the minimum requirements. It is the obligation of the architect to examine the curriculum of the school and the places the majority of the education takes place: the classroom. It is in the classroom where students interact with the teacher and the teacher employs the resources at their disposal to fulfill the curriculum. The architect must take into consideration these resources the teachers have in order to organize the best learning environment. It's also

paramount to study the way children interact with the classroom environment to allow them the best possible opportunity to learn. Everything else in the program needs to react to the classroom design; it is the architect's duty to explore the activities that occur in the classroom to generate the design, anything else would be sheer ignorance.

I am a student of architecture, I see the world as a designer but my wife is an educator and this allows me to see the world from a teacher perspective and the many frustrations that that entails. It's something of special interest to me because my wife and I also have a four year old daughter that is getting ready to enter the educational system. Hearing all of the frustrations of from my wife about the inadequate facilities and poor school layouts that affect the children's ability to learn, I began to wonder it there could possibly be an architectural solution to this. The thought first was a daunting one because of the stigma of public schools and their political policies. The more I researched the topic the more I realized that the architectural design greatly impacts school performance and that perhaps a solution could be found. When I moved here with my young family to attend college I had my sights on moving to a large city to get work after graduation, but the more I lived here the more I realized the Fargo is in need of designers; plus over the years I have grown fond of the city. One of my thoughts was, if my daughter is going to attend school in Fargo, why not design that I'd want her to attend?

This thesis is meant to be an examination of current educational design in this region and proposal for a solution that integrates intense classroom design, teacher's curriculum, passive environmental strategies, and most importantly the examination of the child's educational experience.

Goals of the Thesis

Site Analysis

November 18th 2011-

9:04 a.m. - Arrived at the site for the first time, not that I haven't been here before; I drove by it once when I was lost trying to get back to the main route. I was lost because I saw some roundabouts and decided that it'd be fun to cruise through a few. I never got out of course but I did wonder why this lovely infrastructure was in place but nobody lived around here. There are some apartments to the north but none with access to this sight. This time I came through with an intent go gain a feel for this place that I visited before, only today I brought a camera.

Excited to capture the site on camera, a nice one that I borrowed from a fellow student, I hopped out of the car. I parked the car at the same spot; there was no traffic as usual. It was snowing this morning and it created an interesting effect, the snow didn't seem to stick to the grass but it stuck to the soil, the concrete, and the ice of the drainage feature. I particularly enjoyed how the water became a completely solid form. The snow in the field punctuated the rows from the crop. The most impressive thing that occurred on this trip was the effect that the falling snow. The snow created a foggy effect the generated a visual wall; the wall made the multitude of telephone poles stand out, as the poles moved into the distance and faded away it produced an eerie effect. This anomaly was compounded with the unnerving silence the laid like a blanket all around me. Perhaps it was the density of the air or the fact that any vehicles that existed were too far away. The wind wasn't even bothersome; perhaps it blew over me due

to the north hill. Even though my vision was limited I could still see the imposing hockey arena loomed at me from across the ice, ice that appeared like a perfect plain of white. That's when I really noticed the light posts; they were painted in an enameled black that contrasted sharply with white haze behind it. The poles were obviously special because they didn't resemble the simple poles that reside in Fargo; the horizontal element that held the lighting fixture over the street extended past the vertical structure and had two braces added that clearly meant to exemplify the work that was being done to keep the arm of the post balanced. I enjoyed these posts, quite a bit actually. That's when I noticed that time started to get away from me so I decided to get going but not before exploring the ice. I locked the camera in the car and ventured to the edge of the ice. I became a little apprehensive when I began look

a little apprehensive when I began looking over the perfect sheet of white; not because I was afraid of the ice breaking and my feet getting wet but disturbing the perfectness of the snow cover. Very purposely I rested my foot on the snowy ice, I wanted to make impeccable footprint on this pond. After a few careful steps I felt my weight sweep from underneath me, I was quick enough to catch myself. Foolishly I looked at the mess I made and made my way back. As I came close to the edge I knelt down and swept away the thin layer powder to reveal darkness staring up at me, darkness separated by a pane of crystal. I enjoyed this for a moment before urgency crept back into my mind, reminding me of my obligations; I rushed back to my car and placed it in gear. I paused on the bridge once more to look over the site and left with a sense of wonder and a little excitement. I want to explore this place more, hopefully before holiday break.

Soil:
QUATERNARY PERIOD: HOLOCENE EPOCH:
Clay with thin silt laminae—Flatbedded, commonly laminated; as much as 60 meters (200 feet) thick. Offshore sediment deposited in the deep, quiet water of a lake.
Gravel, sand, silt, clay, and disseminated organic debris—Dark, obscurely bedded; associated in places with sand and gravel of older river-channel sediment; commonly more than one meter (3 feet) thick. Alluvium and overbank sediment deposited in channels and floodplains of ancient rivers and on the Lake Agassiz plain.

Water Drainage:
The runoff water flows straight into the drainage pond adjacent to the site.

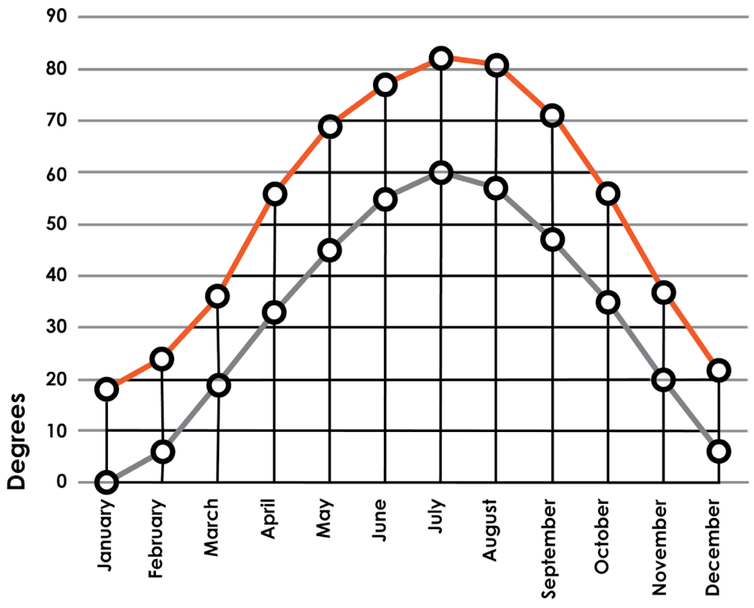
Qualitative Site Maps:

Utilities

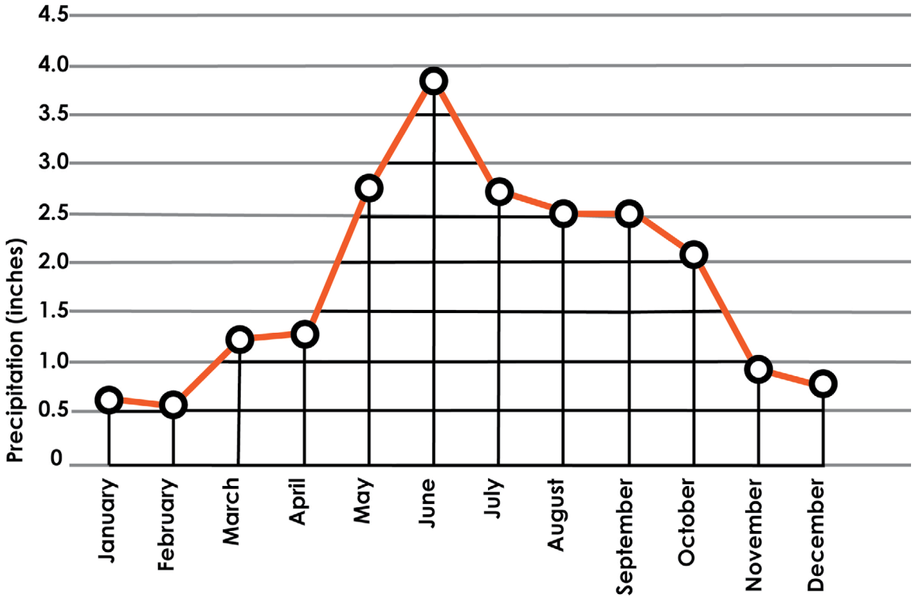
Vehicular Traffic

Pedestrian Traffic

Plant Cover (Grass)

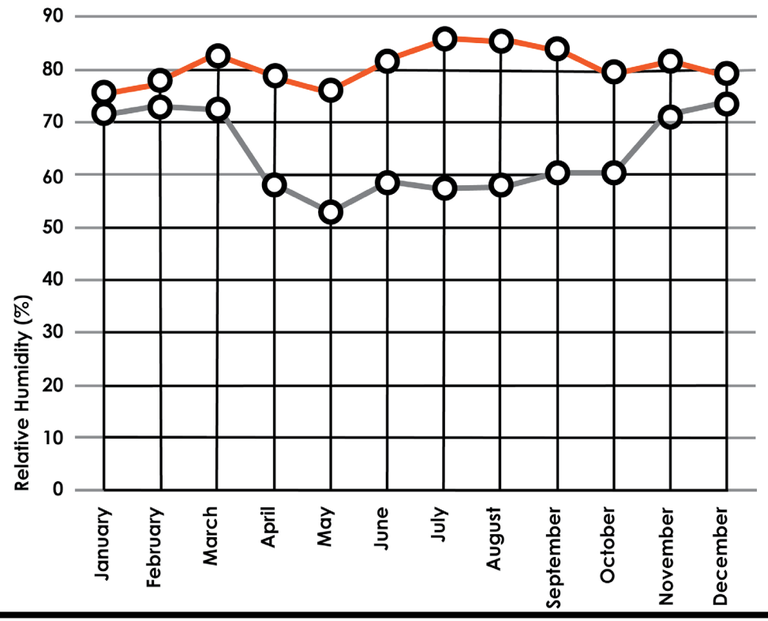


Average Temperature

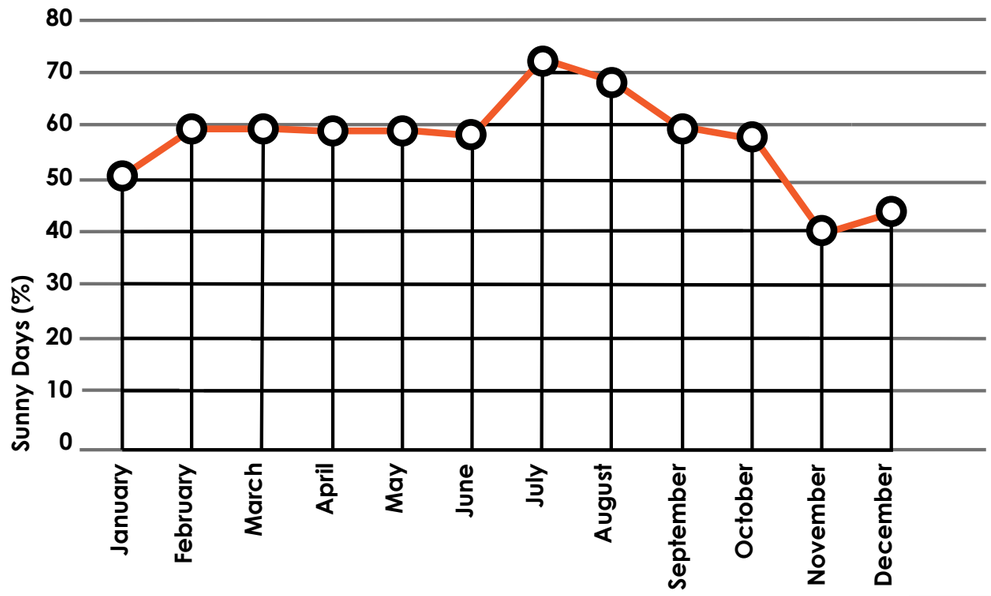


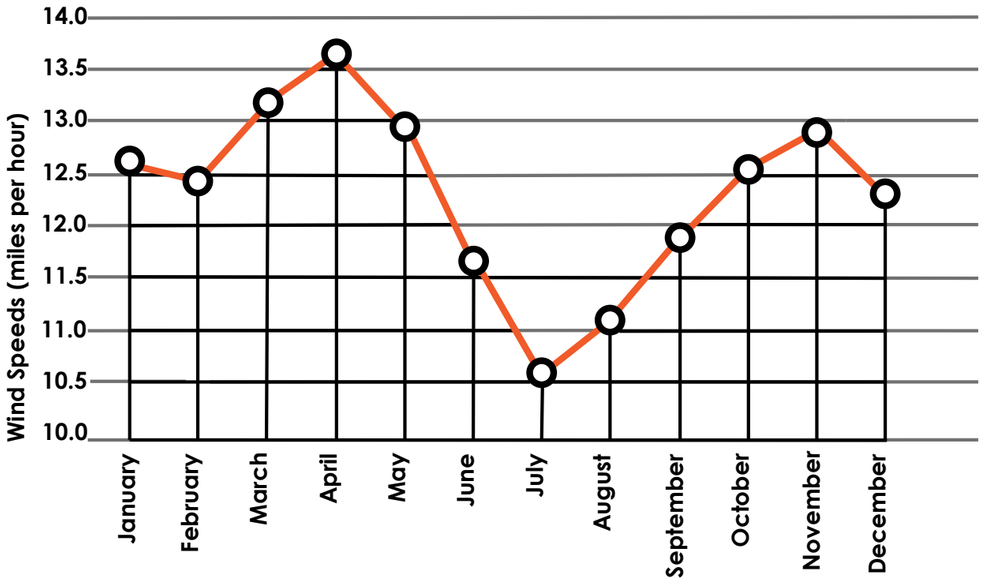
Average Precipitation

Average Relative Humidity

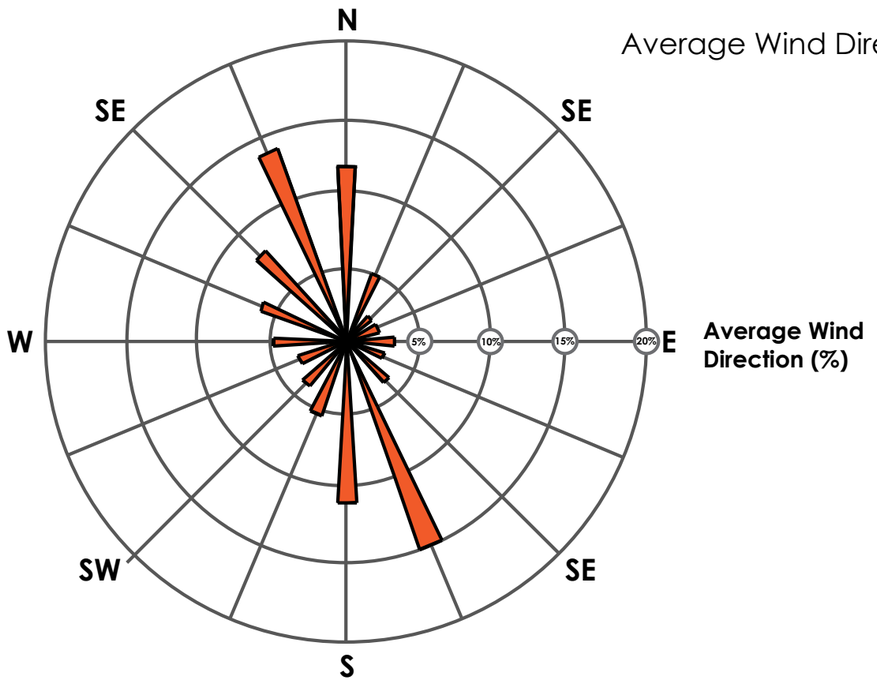


Average Cloudiness

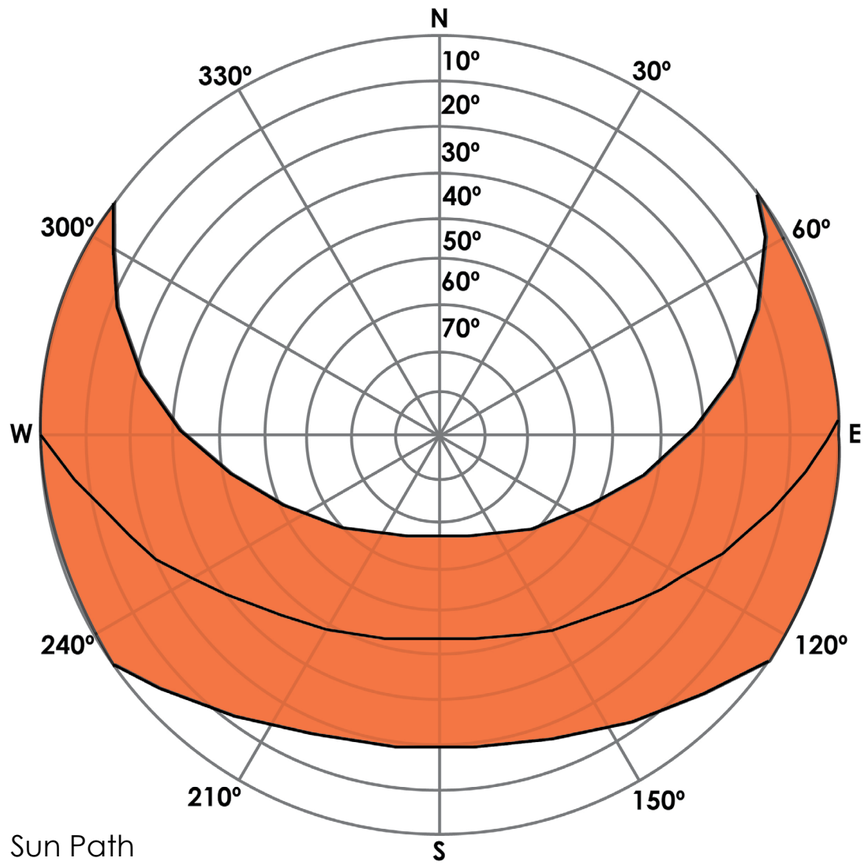




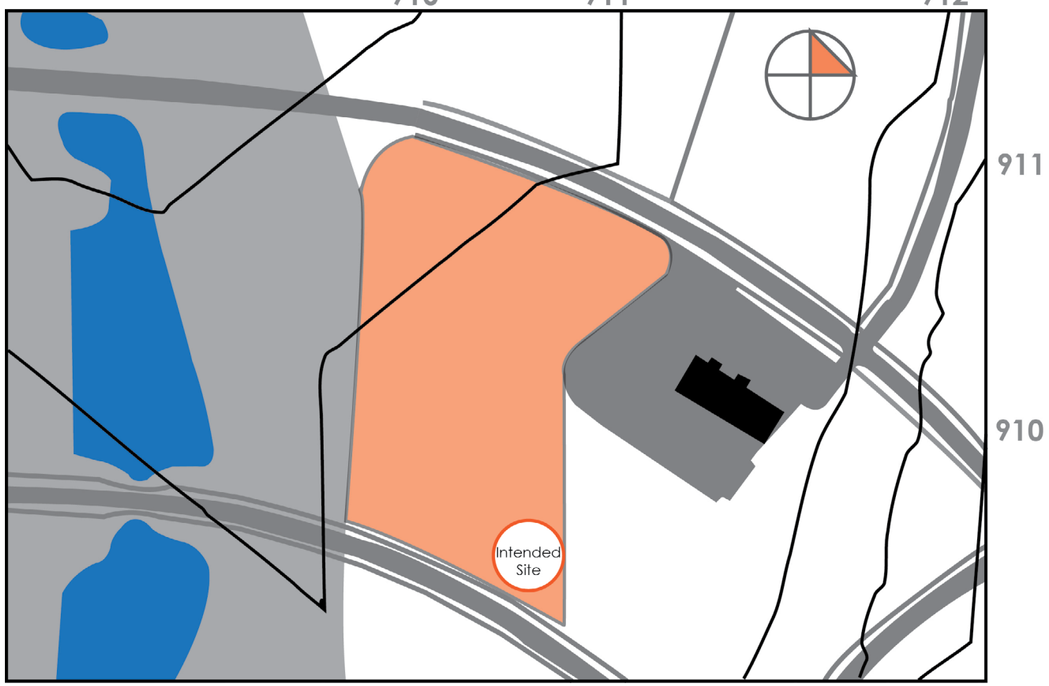
Average Wind Speed



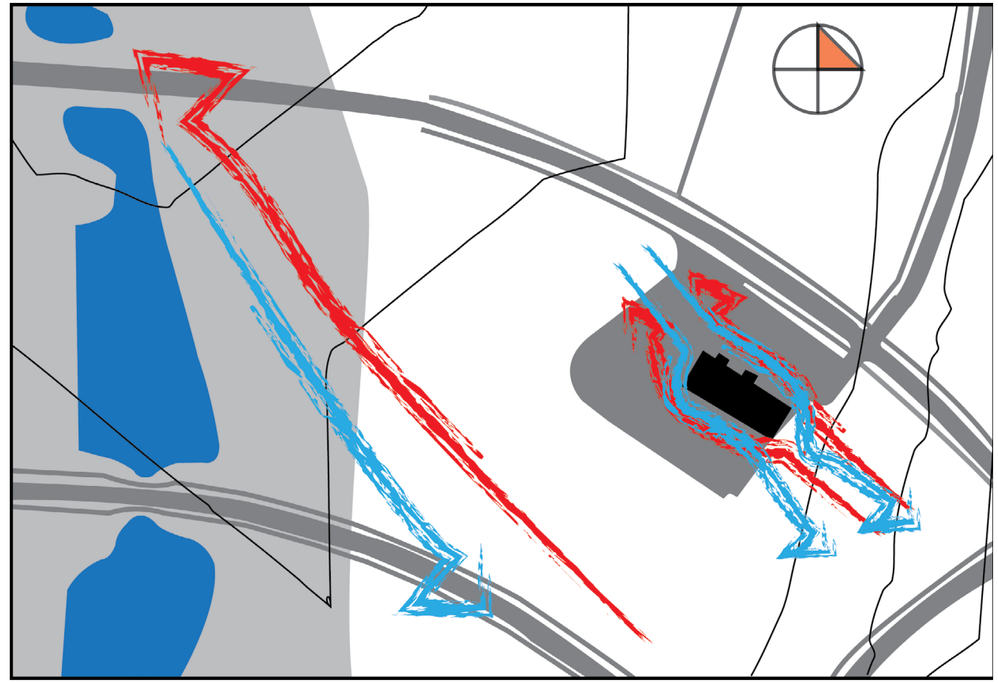
Average Wind Direction



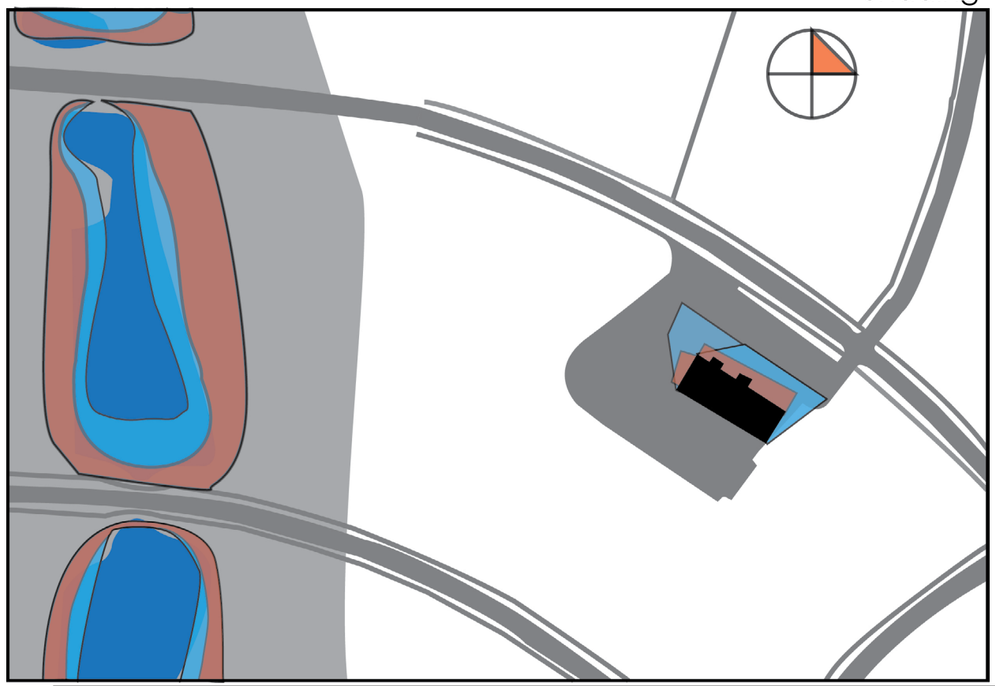
Sun Path



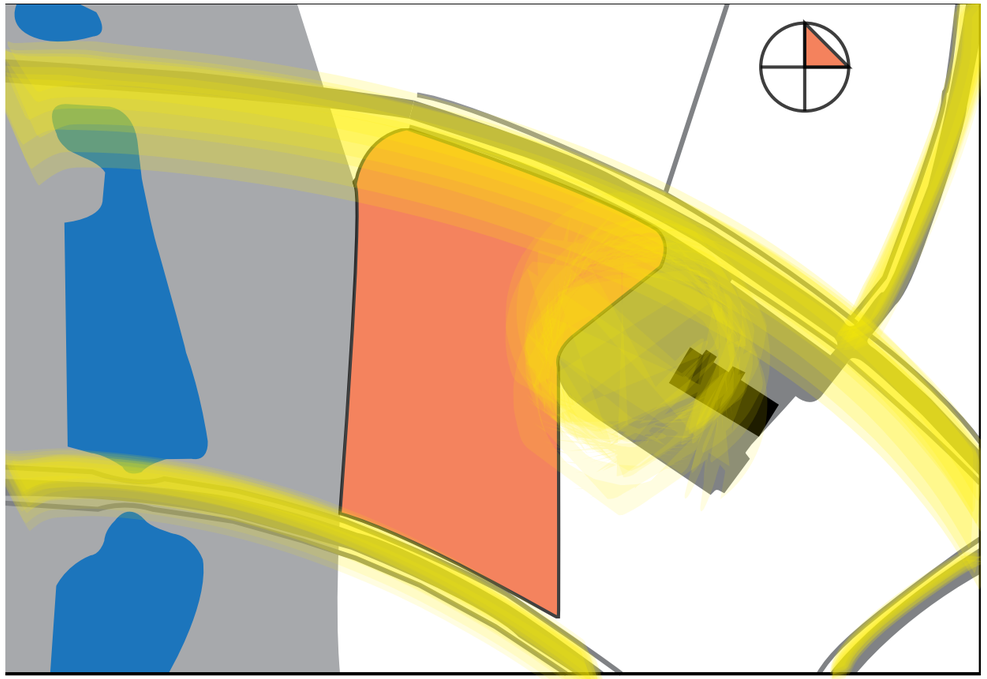
Slope



Air Movement



Shading

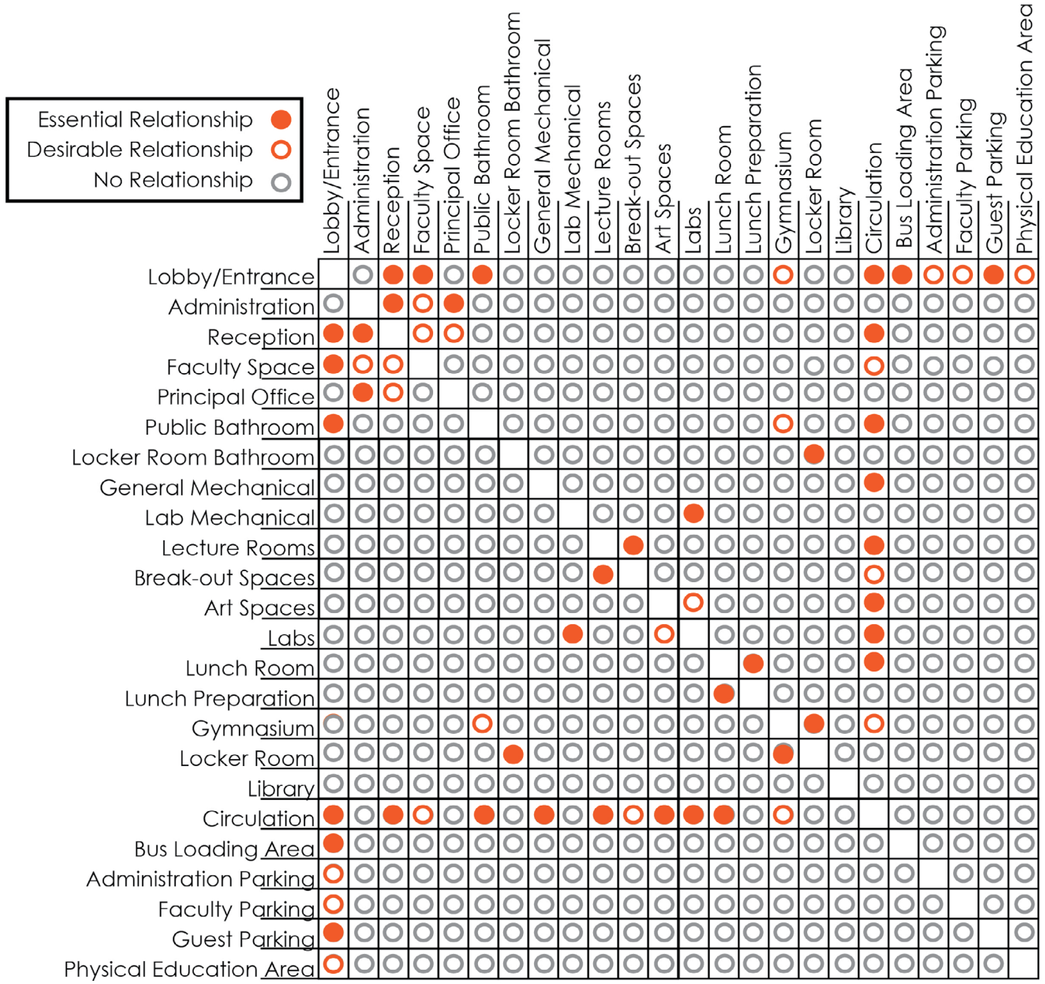


Noise

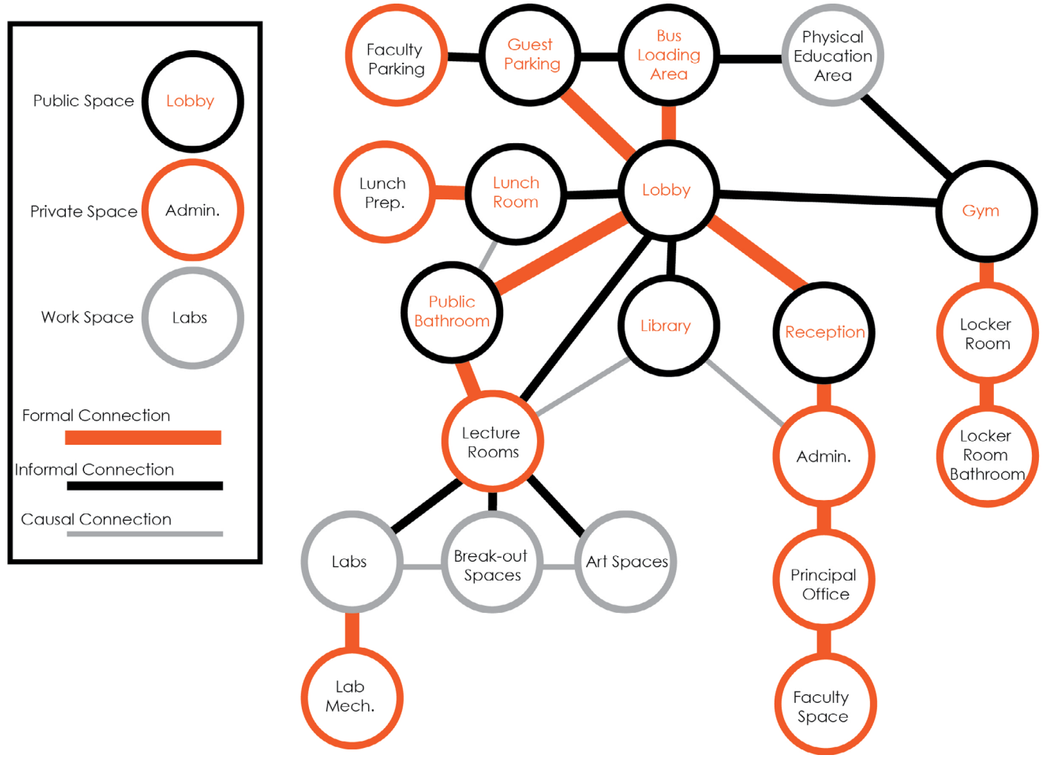
Programmatic Requirements

Minimum Space Allocations

Entry/Lobby	1,200 ft²
Bathroom	250 ft²
Break-out Spaces	
150 ft² X 5	750 ft²
Art Spaces	
250 ft² X 4	1,000 ft²
Labs	
250 ft² X 3	750 ft²
Administration	450 ft²
Faculty	250 ft²
Library	1,500 ft²
Gymnasium	1,300 ft²
Classrooms	
250 ft² X 10	2,500 ft²
Circulation	750 ft²
Mech.	1,000 ft²
Total	**11,700 ft²**

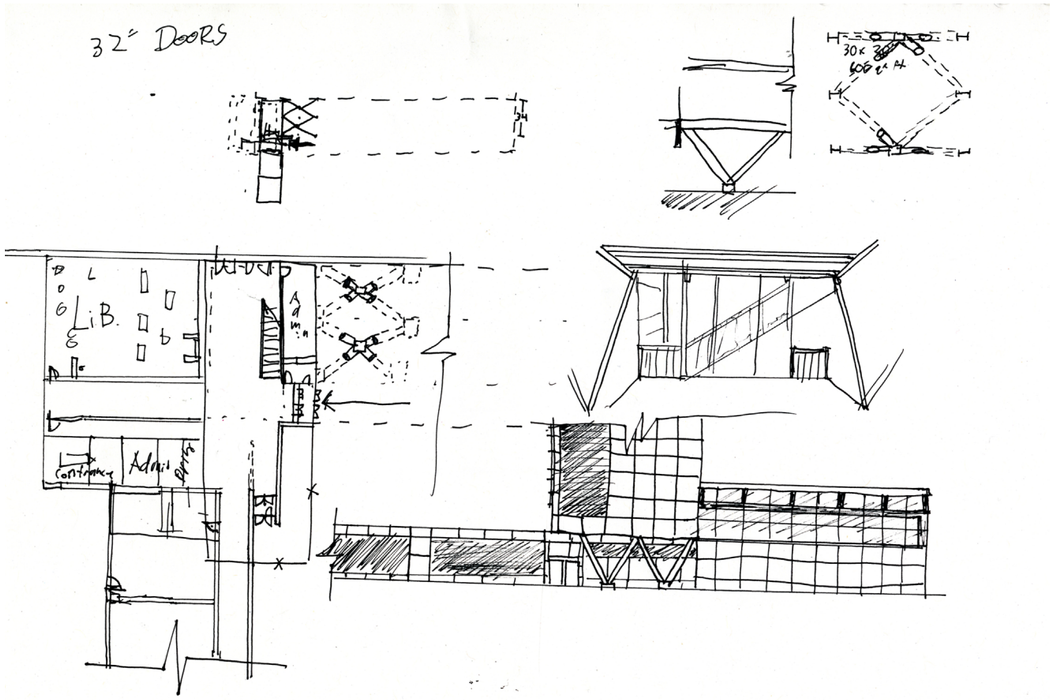


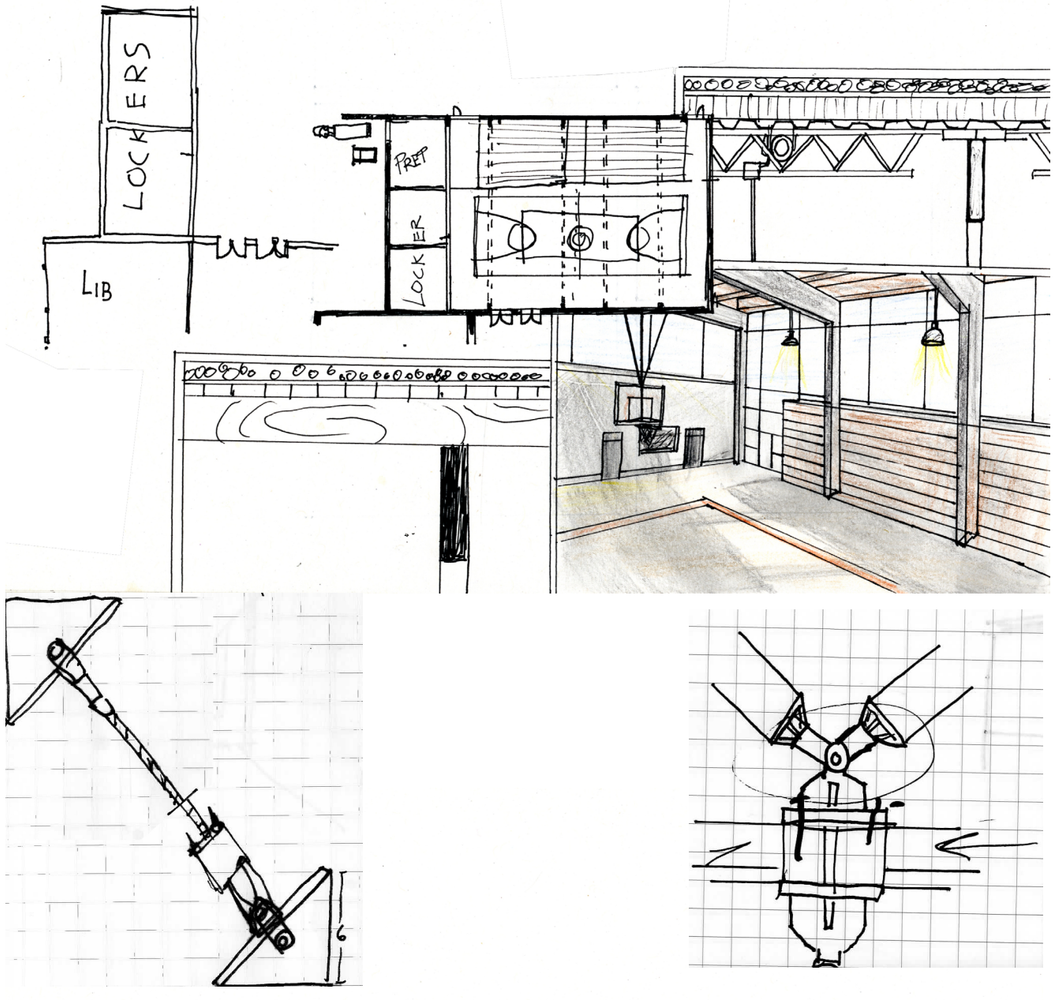
Interaction Matrix

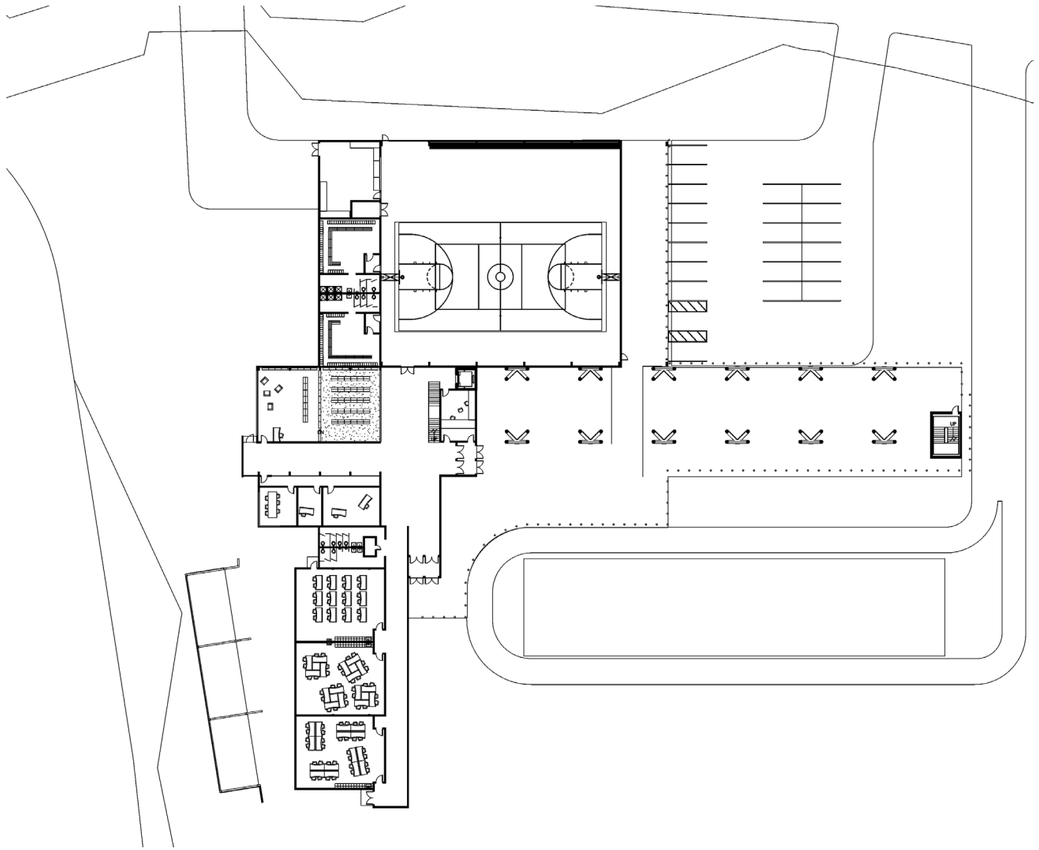


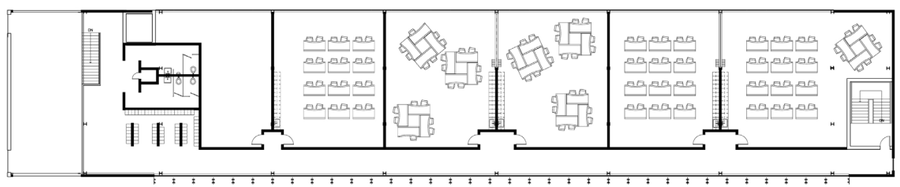
Interaction Net

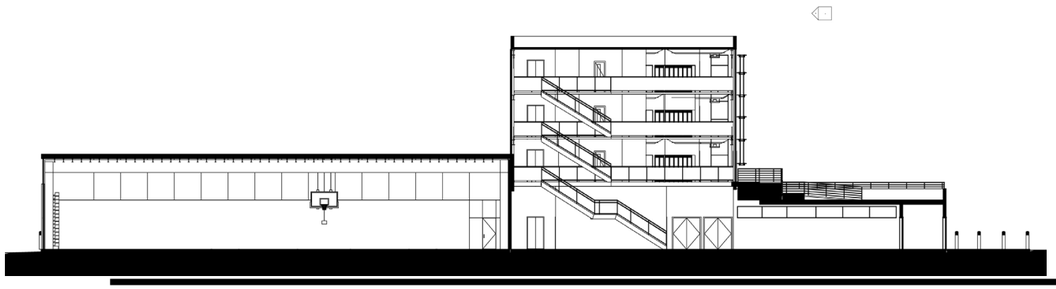
Design Solution

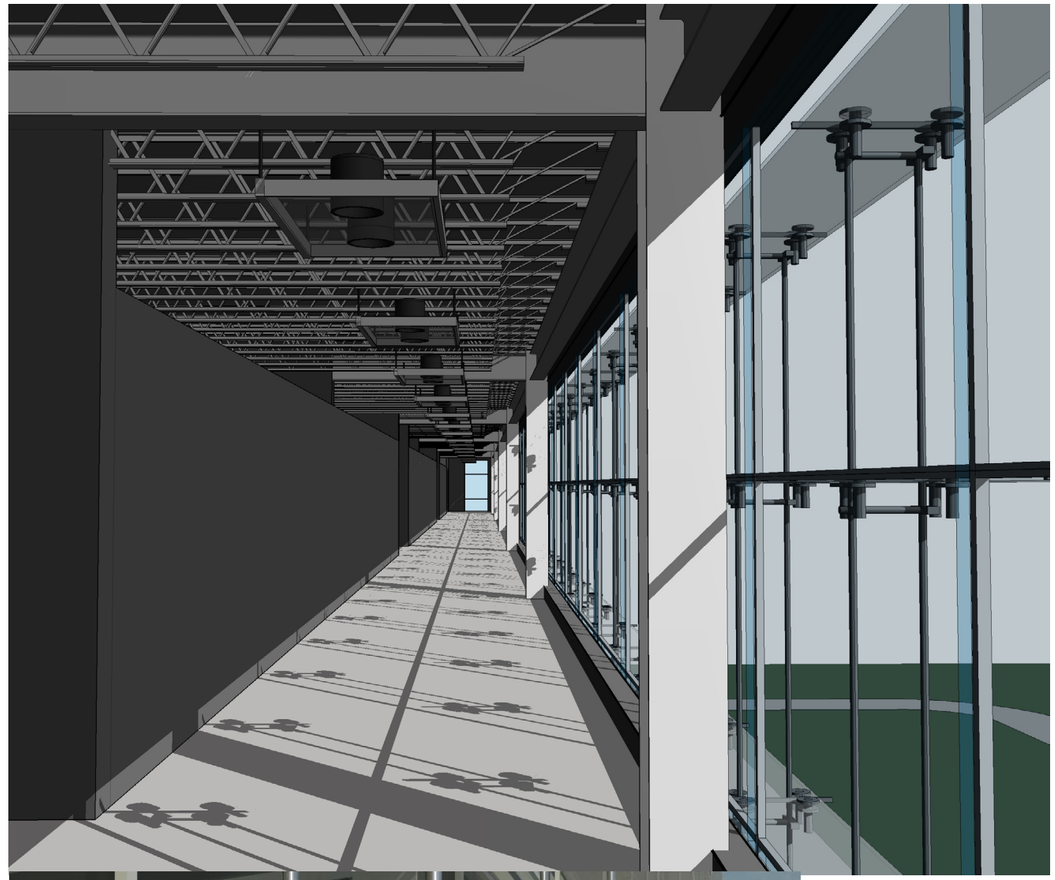

32" DOORS
LIB.
Admin
Corridor
34
15
15 = 1/2 H√3
30 = H√3
30/√3
15'


LOCKERS
LIB
PREP
LOCKER
6'







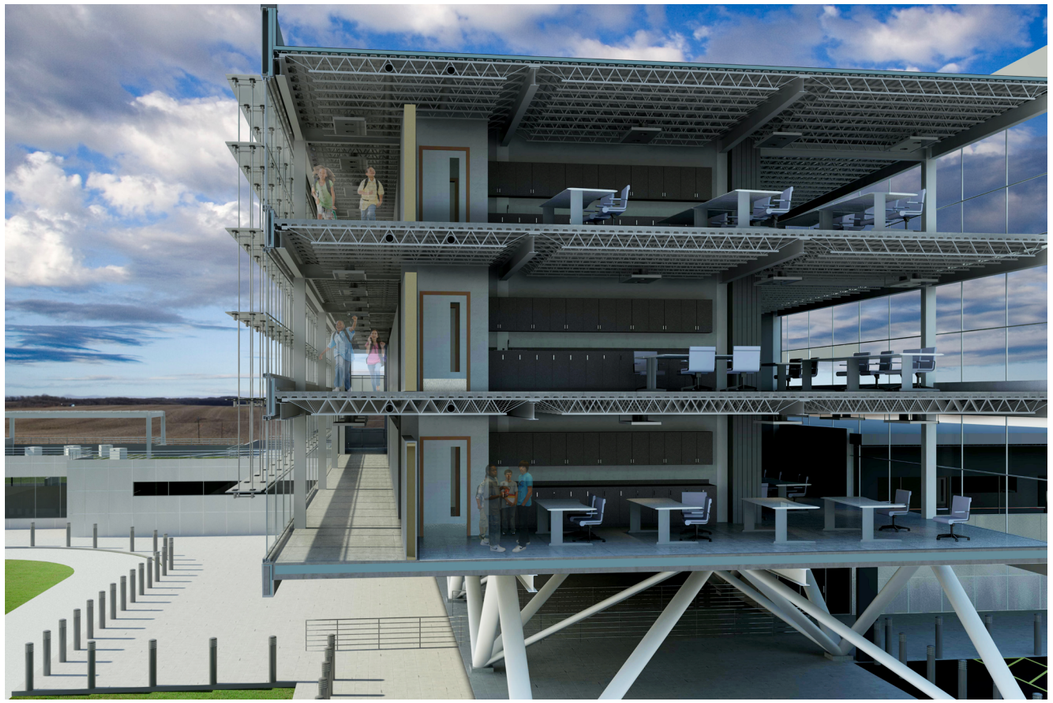


Western Exterior

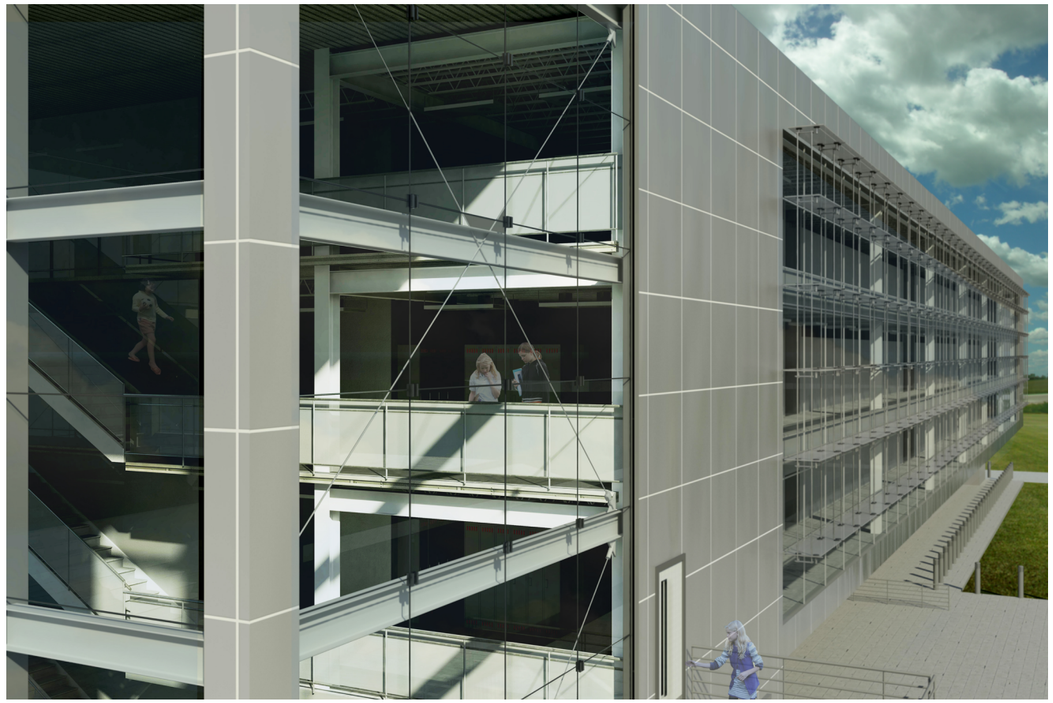
Southern Exterior

Gymnasium

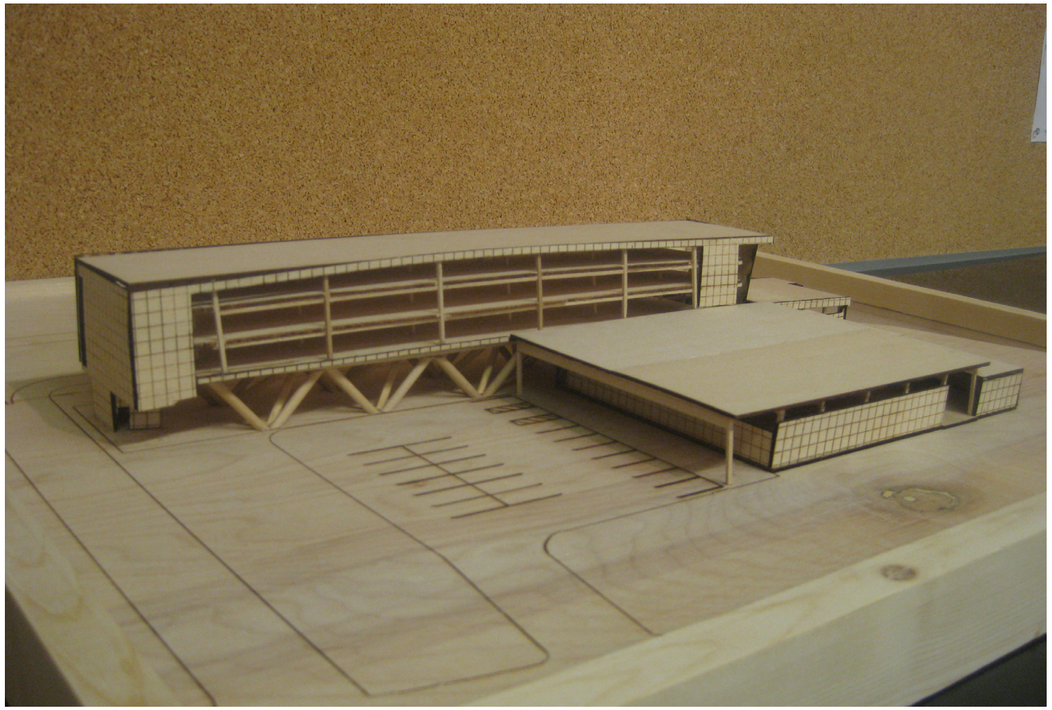
Classrooms

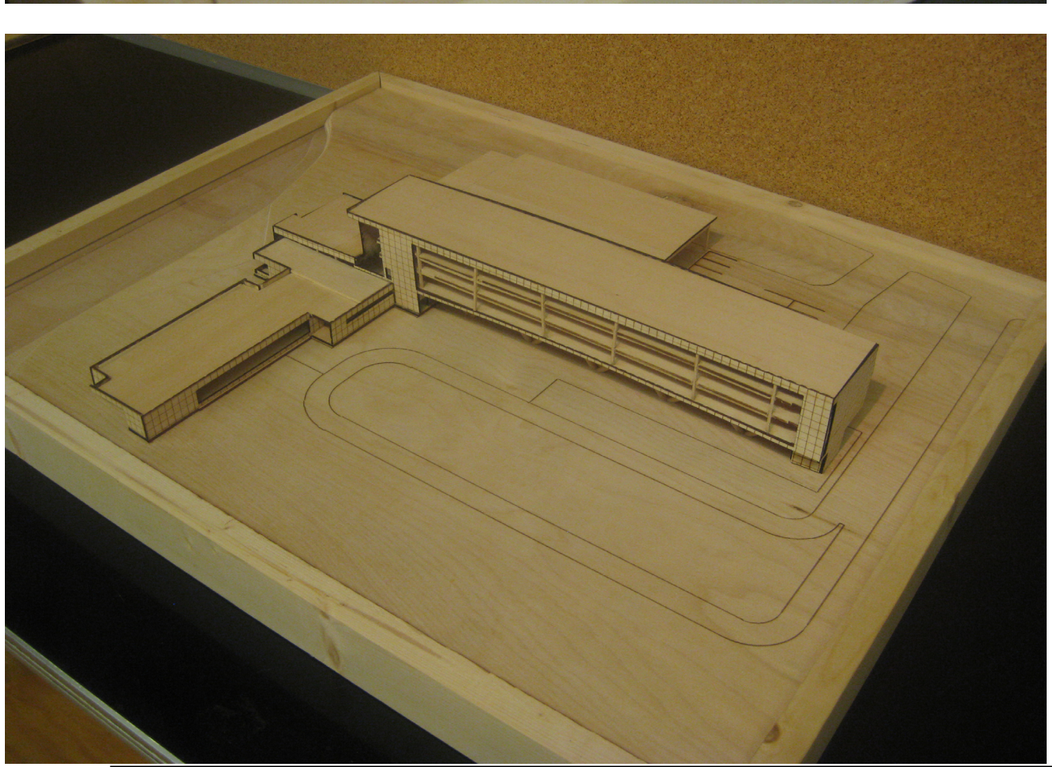


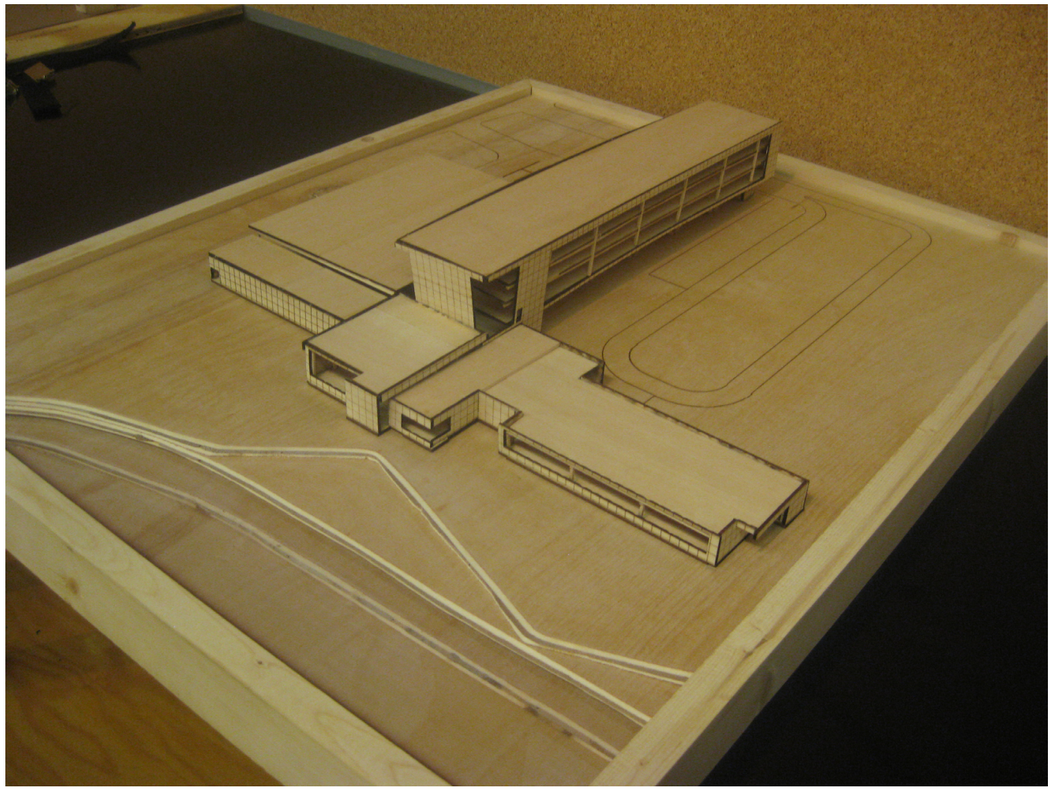
Section



Vertical Circulation







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"This University, the department of architecture more specifically, has helped me achieve, appreciate, and view things I wasn't even able to conceive before starting the program."